



REMOTE - PARIS

Airway management and ventilation strategies for patients in hemorrhagic shock: an evidence based challenge

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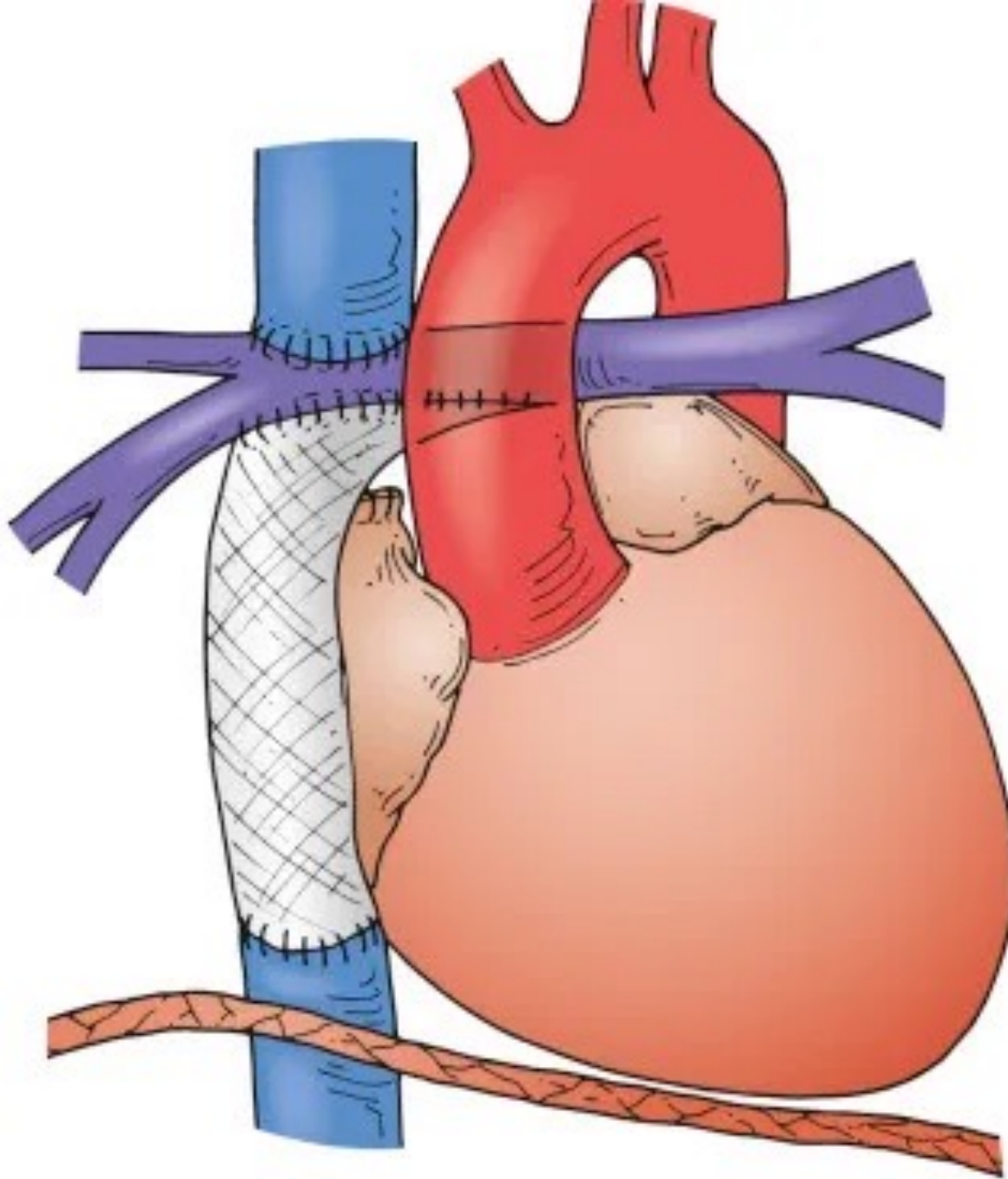
DISCLAIMER

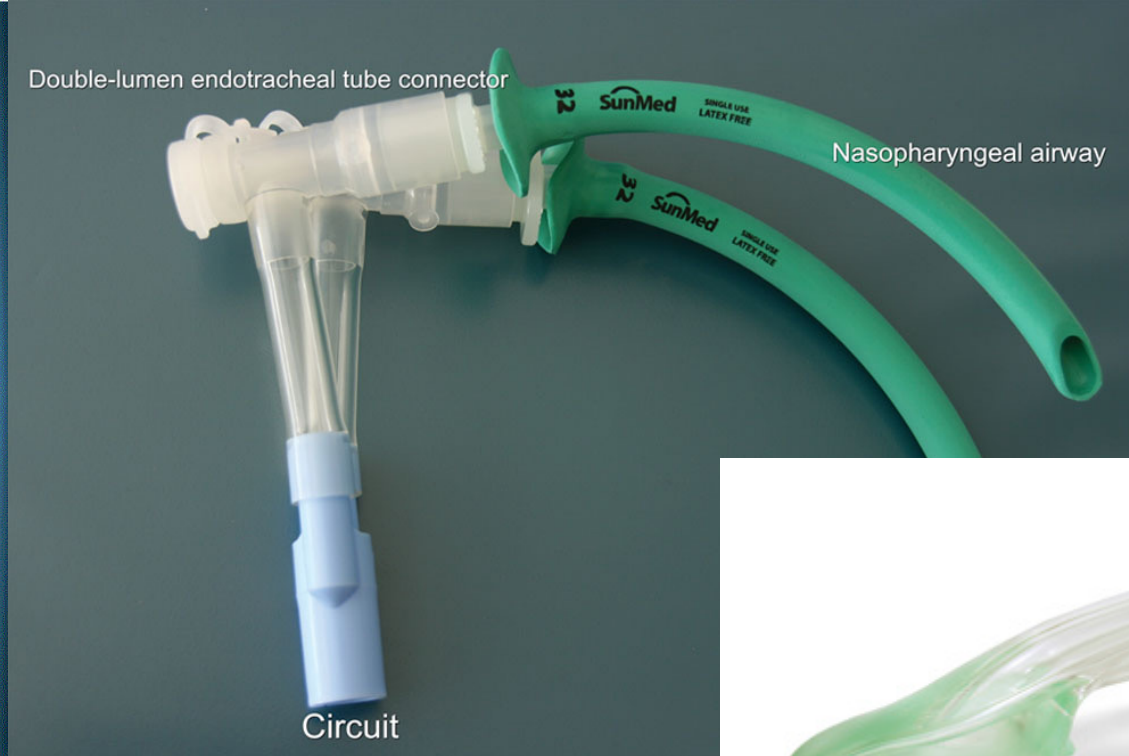
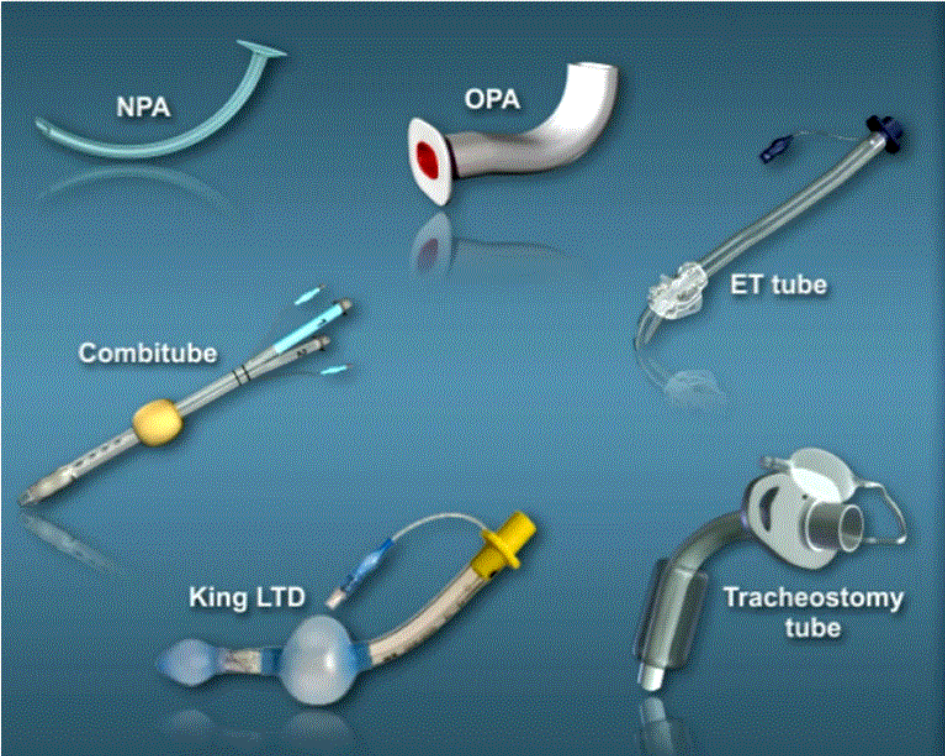
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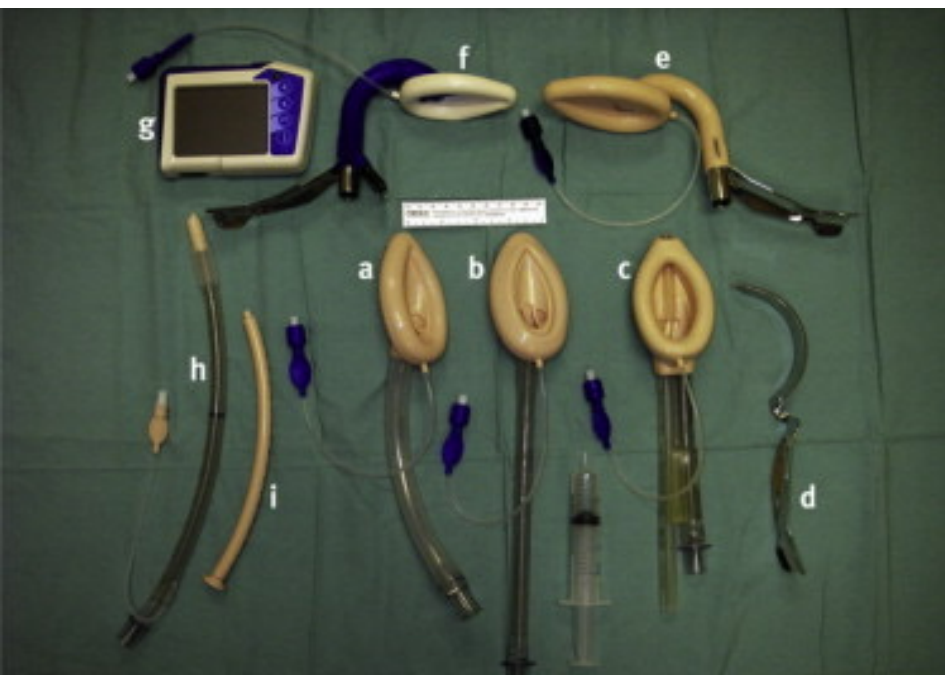
NOT WITHOUT RISK







TOOLS ARE COOL!!



SETUP SHOWN IS TO DEMONSTRATE ESSENTIAL SUPPLIES WHICH MUST BE AVAILABLE.
TO AVOID WASTE AND CONTAMINATION, PLEASE TRY TO KEEP SUPPLIES IN THEIR RESPECTIVE STERILE PACKS




T
H
O
R

PRINCIPLES TO BE FOLLOWED IN COMPLEX RESOURCE POOR ENVIRONMENT

- FIRST: DO NO HARM
- DONT CHOOSE COMPLEX PROCEDURES AS FIRST OPTION
- DO THE SIMPLEST THING THAT COMMON SENCE, RESOURCES,PHYSIOLOGY AND EVIDENCE ALIGN ON

RESEARCH QUESTION??

OR COMMON SENSE ??



DISCONNECT THE HEART LUNG MACHINE??

Tactical Airway Flip

CARE UNDER FIRE

Tactical Recovery Position

CARE UNDER FIRE




THOR

AIRWAY MANAGEMENT

ELECTIVE IN THE OR

VS

SHOCKED TRAUMA

PREHOSPITAL



Elective intubation in OR

Stable patient

Calm controlled environment

Pre oxygenationg

Time to optimise

Extensive Monitoring

Rare that patient need resuscitation post intubation



Elective intubation in ER or Prehospital

~~Stable patient~~

~~Calm controlled environment~~

Pre oxygenation ?? ?

?
Time to optimise

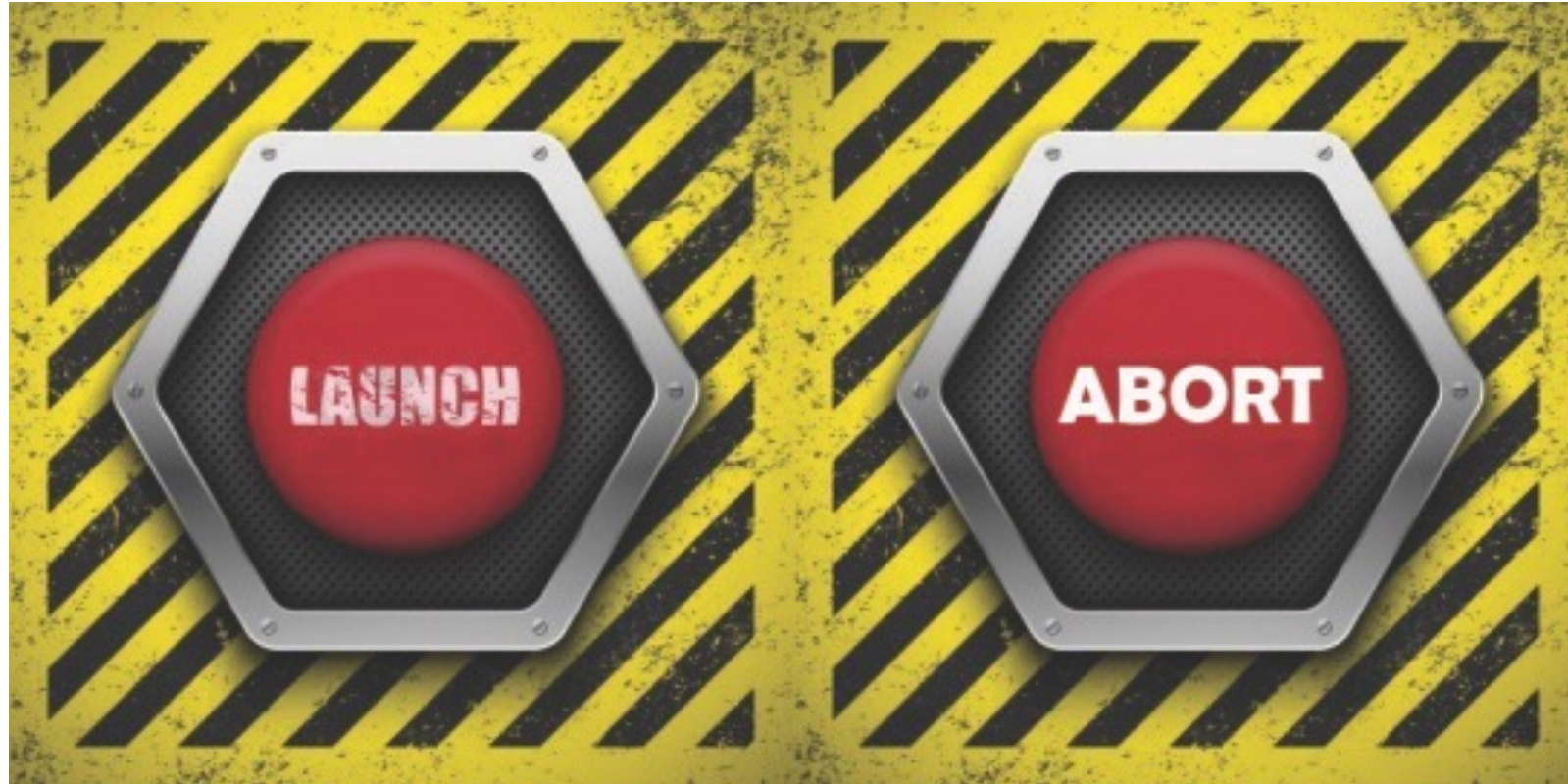
Extensive Monitoring ?

~~Rare that patient need resuscitation post intubation~~





ELECTIVE OR



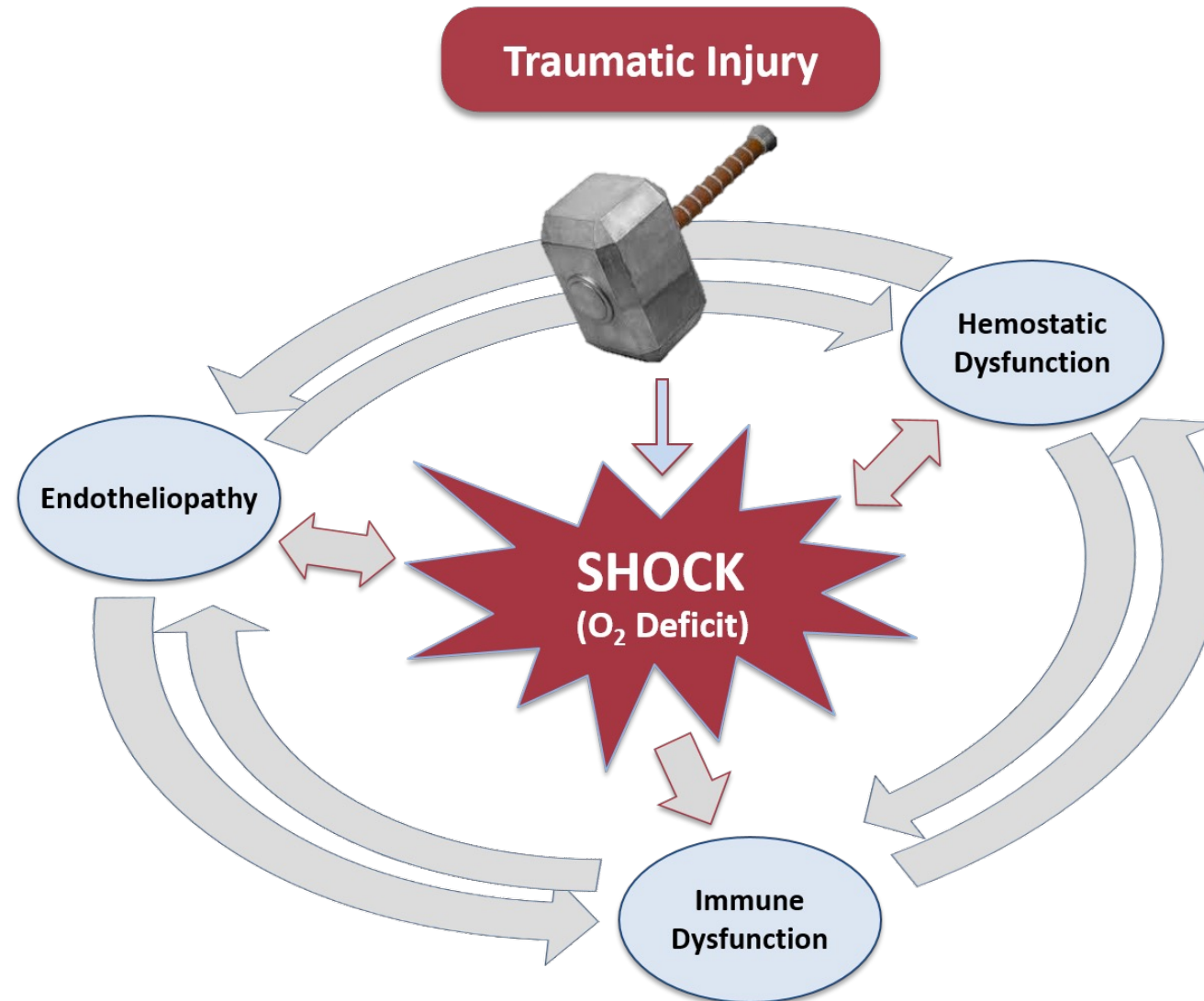


THOR

TRAUMA AND SHOCK



RDCR Principles - Trauma Induced Blood Failure





SUMMARY OF EUROPEAN GUIDELINES

LAST UPDATED 2019

ARE THEY ALIGNED WITH THE PATHOPHYSIOLOGY OF SHOCK??

- Recommendation 16: We recommend that fluid therapy **using isotonic crystalloid solutions be initiated in the hypotensive bleeding trauma patient. (Grade 1A)**
- Recommendation 17: We recommend a target Hb of **7** to 9 g/dl. (**Grade 1C**)
- There are well-defined situations in which **intubation is mandatory**, for example airway obstruction, altered consciousness [Glasgow Coma Score (GCS) ≤ 8], **haemorrhagic shock**, hypoventilation or hypoxaemia
- Recommendation 3: We recommend **normoventilation** of trauma patients. (Grade 1B)
- Recommendation 13: We recommend a **target systolic blood pressure of 80-90 mmHg until major bleeding has been stopped** in the initial phase following trauma without brain injury. (Grade 1C)



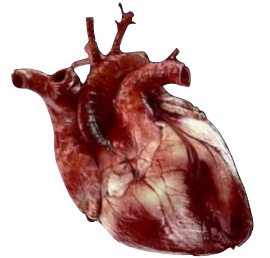
WE LOVE CUT OFF NUMBERS DON`T WE?? USEFUL??

- SYST BP 80-90
- HB 7-9
- SP02 > 92
- GCS < 8
- ETC ETC ETC



FICK`S EQUATION

$$DO_2 = 1.34 \times Hgb \times SaO_2 \times CO$$



YOU MIGHT HAVE A DIFFERENT OPINION
BUT YOU CAN`T CHOOSE YOUR OWN
PHYSIOLOGY

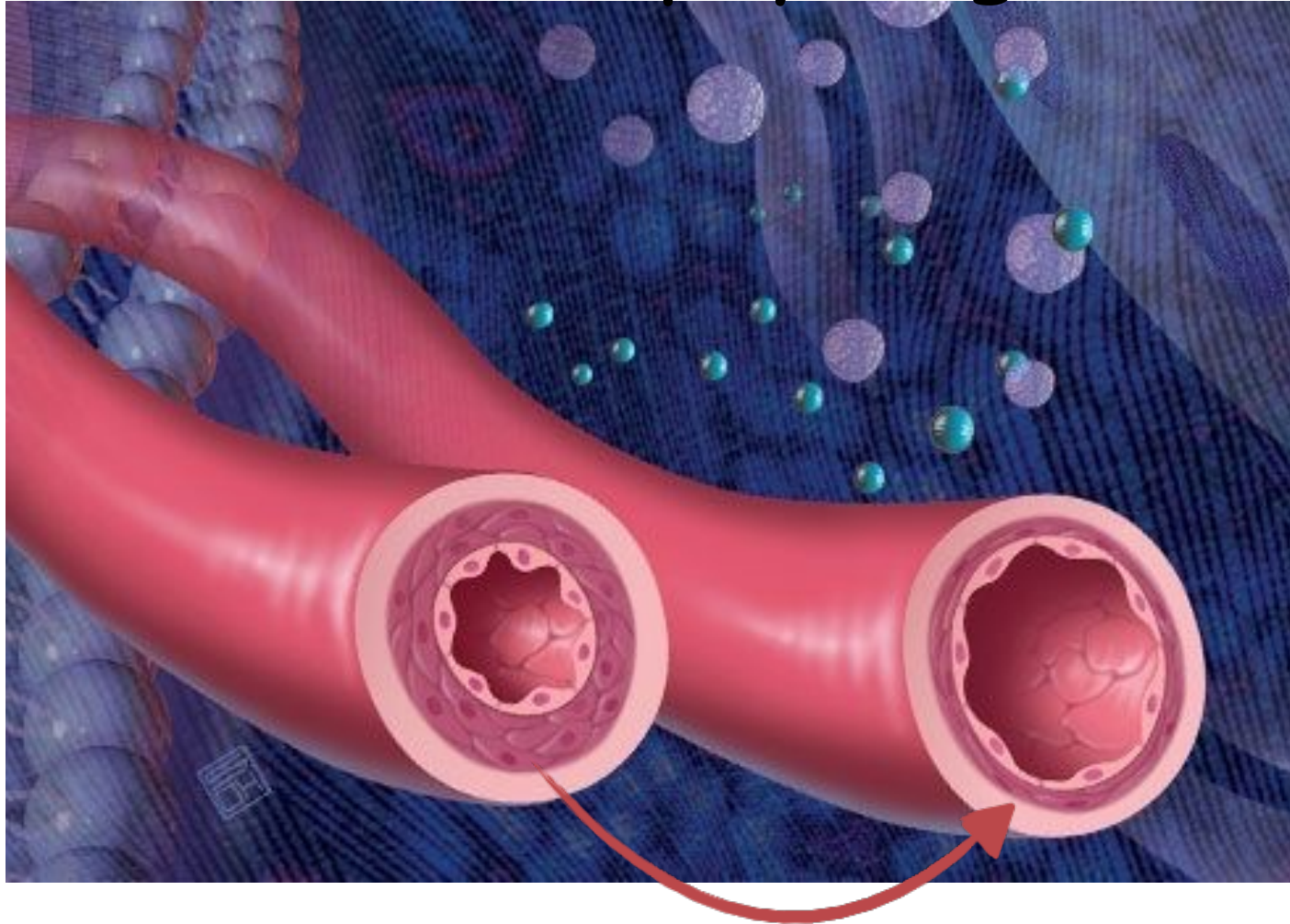


THOR

DOES RSI AND PPV IMPROVE OXYGEN DELIVERY IN PATIENT WITH SEVERE CENTRAL HYPOVOLEMIA ??

- REVERSAL OF THE NEGATIVE INTRATHORACIC PRESSURE PUMP
- MUSCULOVENOUS PUMP ELIMINATED
- REDUCED VASCULAR TONE

2 different physiologies

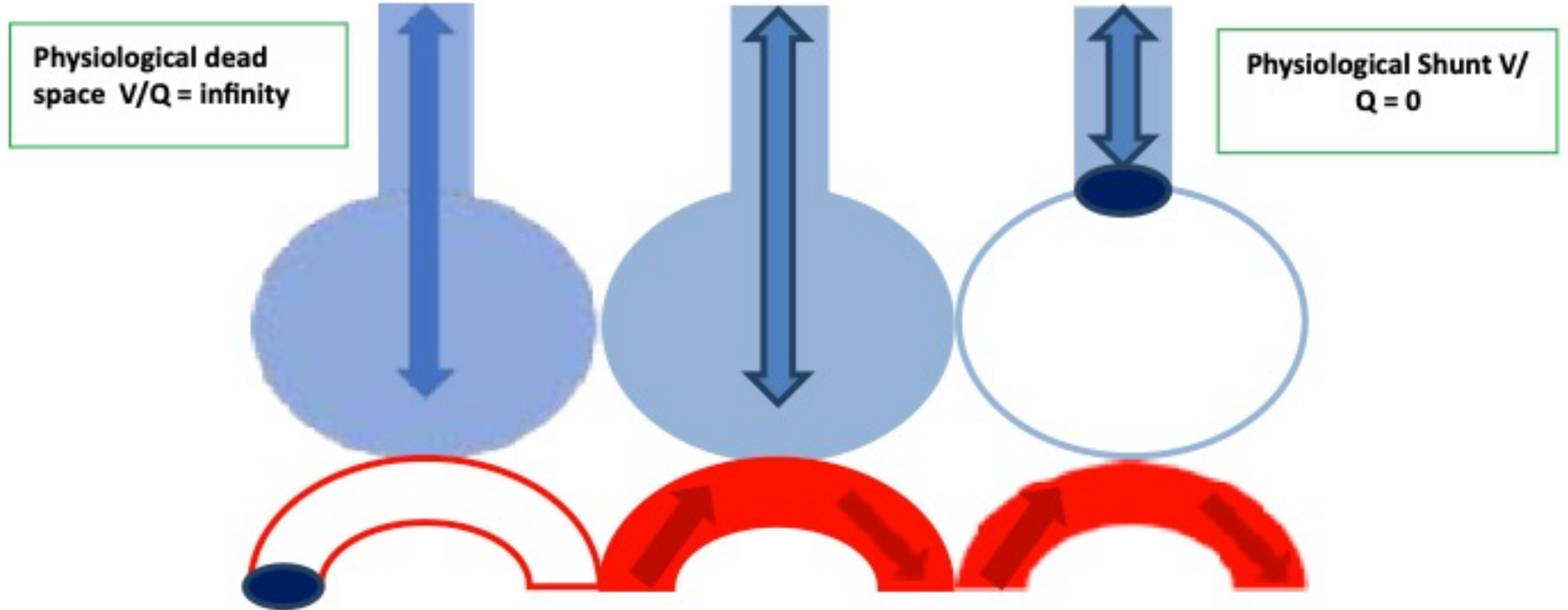


Anesthesia

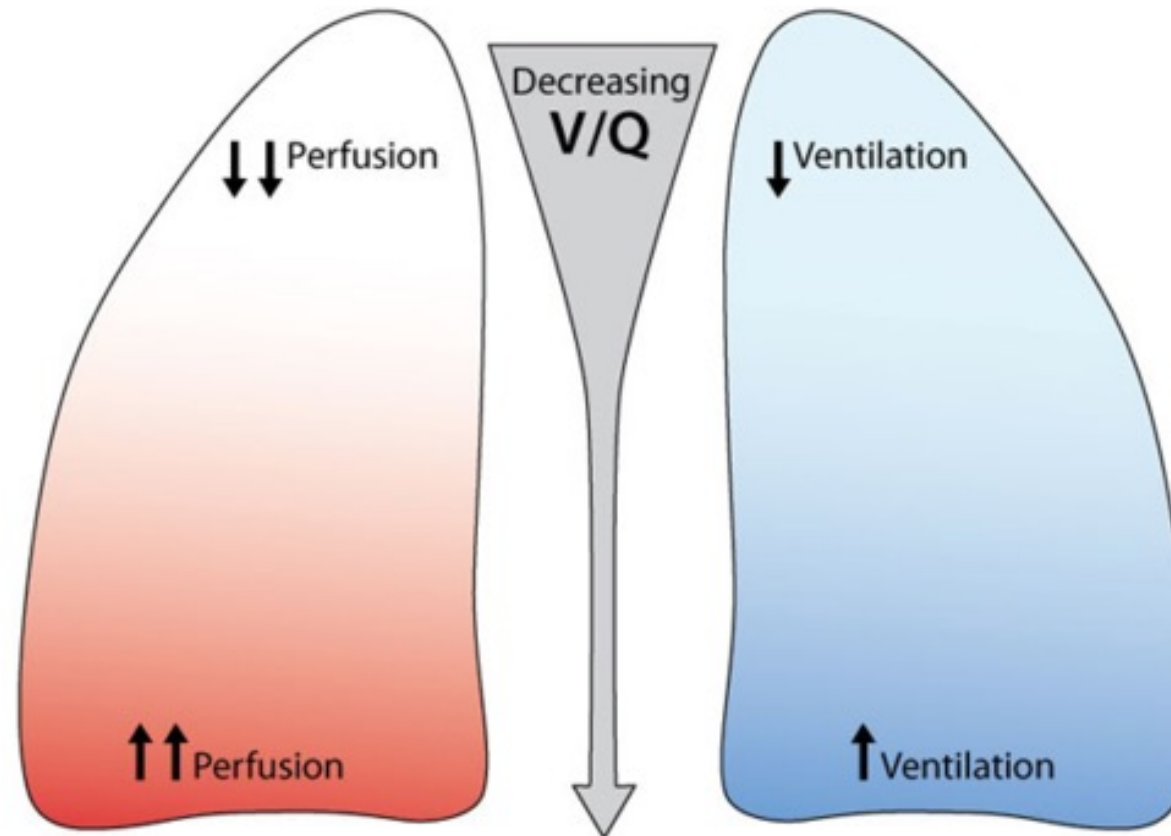
Prehospital spontaneous breathing versus OR in general anesthesia



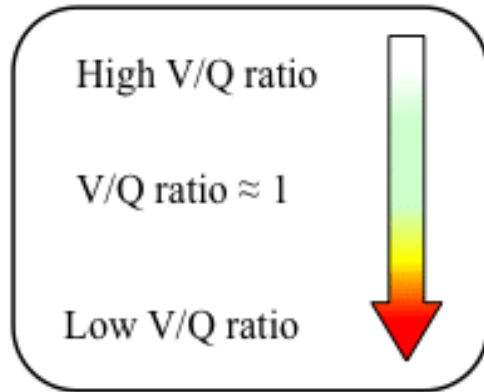
Deadspace and shunting (V/Q mismatch)



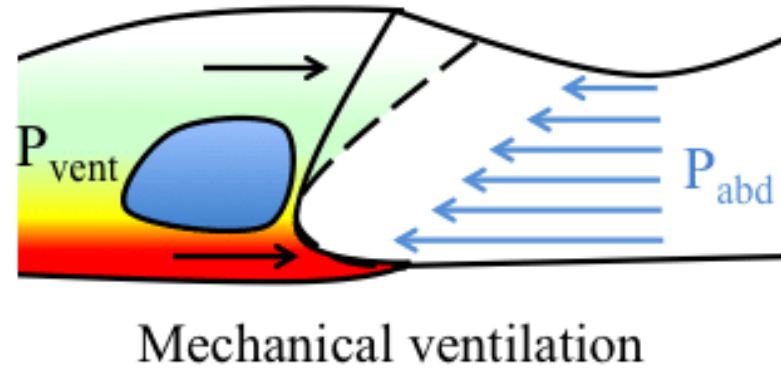
V/Q IN THE LUNGS



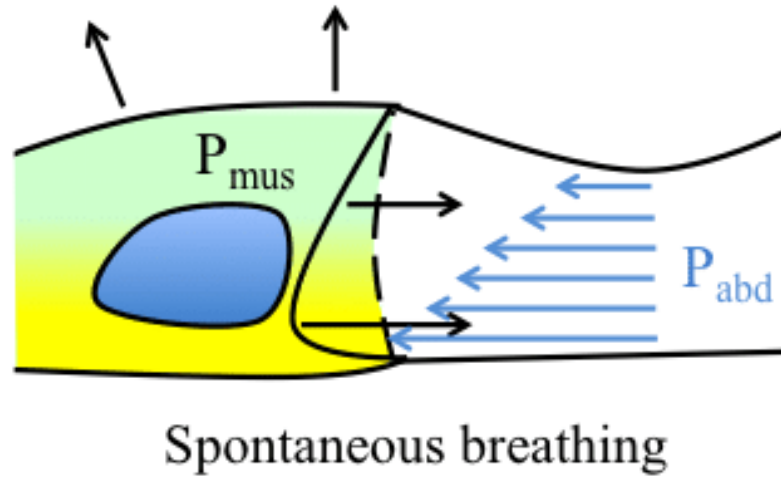
While both ventilation and perfusion are increased at the base of the lung due to the effects of gravity, the perfusion increase is far greater, causing the V/Q ratio to decrease from the apex to the base



A



B





THOR

PLAYING WITH NUMBERS

$$DO_2 = 1.34 \times Hgb \times SaO_2 \times CO$$

- Healthy well trained 85 kg resting $V_{O2} = 340$ ml O_2 /min
- Critical DO_2 is 1,3 times the resting $V_{O2} = 442$ ml O_2 /min
- SYST 80 – 90 mmHg = 50% reduction in $CO = 3$ l/min
- $1,34 \times 13 \times 0,85 \times 30 = 444,21$ ml O_2 /min
- $1,34 \times 13 \times 0.96 \times 20 = 334,46$ ml O_2 /min



Association of out-of-hospital advanced airway management with outcomes after traumatic brain injury and hemorrhagic shock in the ROC hypertonic saline.

Wang HE, et al. Emerg Med J 2014;31:186-191. doi:10.1136/emmermed-2012-202101

- The adverse association between out-of-hospital AAM and injury outcome is most pronounced in patients with haemorrhagic shock (includes cardiac arrest).



Expert-Performed Endotracheal Intubation-Related Complications in Trauma Patients: Incidence, Possible Risk Factors, and Outcomes in the Prehospital Setting and Emergency Department.

Hindawi Emergency Medicine International Volume 2018, Article ID 5649476, 9 pages
<https://doi.org/10.1155/2018/5649476>

- In this study of trauma patients who underwent expert performed ETI for airway compromise, severe ETI-related adverse events were common and were associated with low GCS, elevated heart rate, and repeated ETI attempts. **The occurrence of these airway-related complications decreased the likelihood of survival of injured patients, independently of anatomic severity and physiological reserve.**



2001

[BMJ](#). 2001 Jul 21; 323(7305): 141.

PMCID: PMC34726

PMID: [11463683](#)

Survival of trauma patients who have prehospital tracheal intubation without anaesthesia or muscle relaxants: observational study

[David Lockey](#), fellow in prehospital care, [Gareth Davies](#), consultant in accident and emergency and prehospital care, and [Tim Coats](#), senior lecturer

486 trauma patients intubated without drugs

1 survived

As almost all the trauma patients intubated without the use of drugs died, the value of this practice is doubtful. To allow easy passage of a tracheal tube without anaesthetic drugs, a patient must be profoundly unconscious, and a high likelihood of death might be expected. Despite this expectation, it was surprising that the outcome was almost always fatal.



2005

J Trauma. 2005 Nov;59(5):1140-5; discussion 1145-7.

Pre-hospital endotracheal intubation and positive pressure ventilation is associated with hypotension and decreased survival in hypovolemic trauma patients: an analysis of the National Trauma Data Bank.

Shafi S¹, Gentilello L.

CONCLUSIONS: Pre-hospital endotracheal intubation in trauma patients is associated with hypotension and decreased survival. This may be mediated by the effect of positive pressure ventilation during hypovolemic states.



2012



Journal of Critical Care

Volume 27, Issue 4, August 2012, Pages 417.e9-417.e13



Ventilation

The frequency and significance of postintubation hypotension during emergency airway management ☆

Alan C. Heffner MD ^{a, b}, Douglas Swords BA, MS III ^b, Jeffrey A. Kline MD ^b, Alan E. Jones MD ^{b, c}  

Postintubation hypotension occurs in almost one quarter of normotensive patients undergoing emergency intubation. Postintubation hypotension is independently associated with higher in-hospital mortality and longer intensive care unit and hospital LOS



2014

PLoS One. 2014 Nov 17;9(11):e112779. doi: 10.1371/journal.pone.0112779. eCollection 2014.

Factors associated with the occurrence of cardiac arrest after emergency tracheal intubation in the emergency department.

Kim WY¹, Kwak MK², Ko BS³, Yoon JC⁴, Sohn CH³, Lim KS³, Andersen LW⁵, Donnino MW⁶.

Systolic hypotension prior to intubation, defined as a systolic blood pressure ≤ 90 mmHg, was independently associated with post-intubation CA (OR, 3.67 [95% CI, 1.58-8.55], $p = 0.01$)



2017

A systematic review and meta-analysis comparing mortality in pre-hospital tracheal intubation to emergency department intubation in trauma patients

Espen Fevang , Zane Perkins, David Lockey, Elisabeth Jeppesen and Hans Morten Lossius

Critical Care 2017 21:192

<https://doi.org/10.1186/s13054-017-1787-x> | © The Author(s). 2017

Received: 20 February 2017 | Accepted: 5 July 2017 | Published: 31 July 2017

Cardiovascular collapse is a known complication of TI in this patient group, and some centres deliberately postpone in-hospital TI in patients in shock until after initial stabilization



2018

J Trauma Acute Care Surg. 2018 Jun;84(6S Suppl 1):S77-S82. doi: 10.1097/TA.0000000000001822.

Airway and ventilation management strategies for hemorrhagic shock. To tube, or not to tube, that is the question!

Hudson AJ¹, Strandenes G, Bjerkvig CK, Svanevik M, Glassberg E.

The potentially harmful effects of drug-assisted intubation and positive pressure ventilation include reduced cardiac output, apnea, hypoxia, hypocapnea, and unnecessarily prolonged on-scene times. Conversely, the beneficial effects of spontaneous negative pressure ventilation on cardiac output are well described.

delayed intubation should be strongly encouraged



2020

EXPERT OPINION PAPER

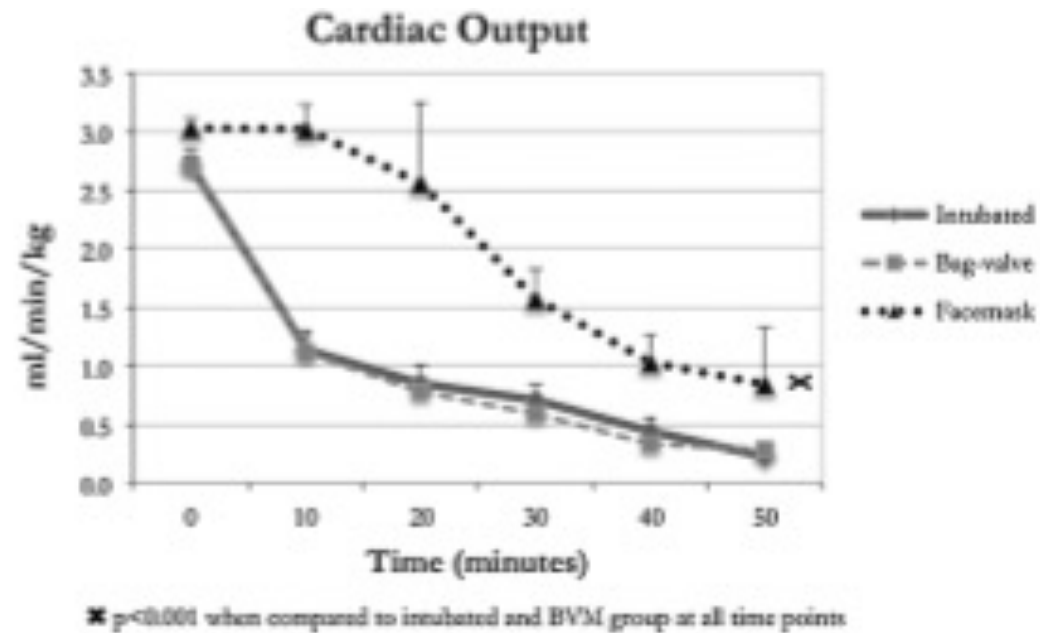
Risk of Harm Associated With Using Rapid Sequence Induction Intubation and Positive Pressure Ventilation in Patients With Hemorrhagic Shock

Patrick Thompson, MPara^{1*}; Anthony Hudson, FRCPEd, FRCER²; Victor A. Convertino, PhD³;
Christopher Bjerkvig, MD⁴; Håkon S. Eliassen, MD⁵; Brian J. Eastridge, MD⁶;
Timm Irvine-Smith, CCP⁷; Maxwell A. Braverman, DO⁸; Stefan Hellander, MD⁹;
Donald H. Jenkins, MD, FACS¹⁰; Joseph F. Rappold, MD, FACS¹¹; Jennifer M. Gurney, MD, FACS¹²;
Elon Glassberg, MD, MHA¹³; Andrew P. Cap, MS, MD, PhD, FACP¹⁴; Sylvain Ausset, MD¹⁵;
Torunn O. Apelseth, MD, PhD¹⁶; Steve Williams, RN¹⁷; Kevin R. Ward, MD¹⁸;
Stacy A. Shackelford, MD¹⁹; Pierre Stroberg, CRNA²⁰; Bjarne H. Vikenes, MD²¹;
Paul E. Pepe, MD, MPH²²; Christopher J. Winckler, MD, LP²³; Tom Woolley, MD, FRCA²⁴;
Stefan Enbuske, MD²⁵; Marc De Pasquale, MD²⁶; Ken D. Boffard, MB, BCH, FRCS, FRCS(Edin),
FRCPS(Glas), FCSSA, FACS(Hon)²⁷; Ivar Austlid, MD²⁸; Theodore K. Fosse, MD²⁹;
Helge Asbjørnsen, MD³⁰; Philip C. Spinella, MD, FCCM³¹; Geir Strandenes, MD³²

“In hemorrhagic shock, or any low flow (central hypovolemic) state, it should be noted that RSI and PPV are likely to cause iatrogenic harm by decreasing cardiac output.”



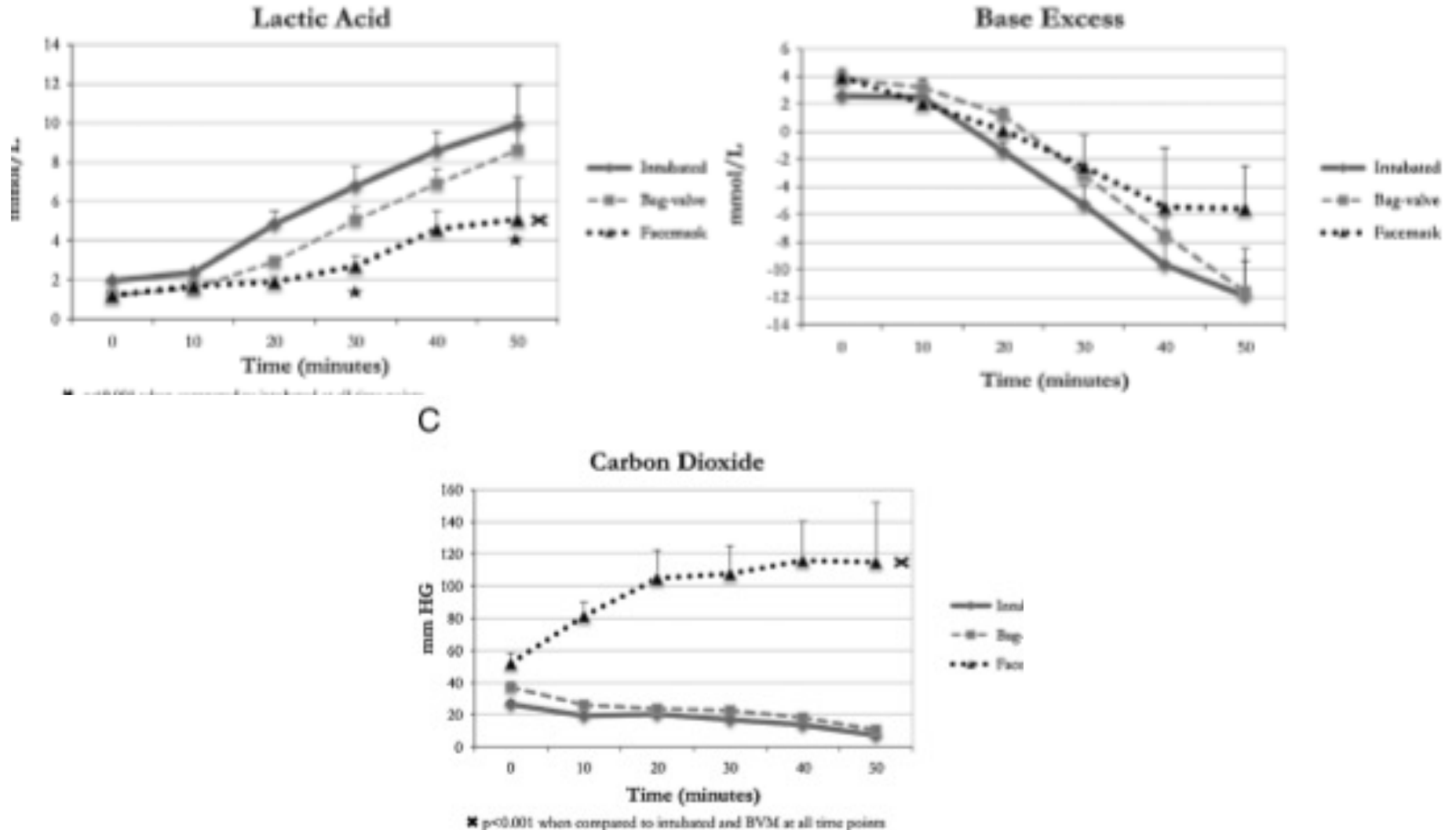
“Permissive hypoventilation” in a swine model of hemorrhagic shock



EAST 2014 PLENARY PAPER



“Permissive hypoventilation” in a swine model of hemorrhagic shock







THIS



NOT
THIS

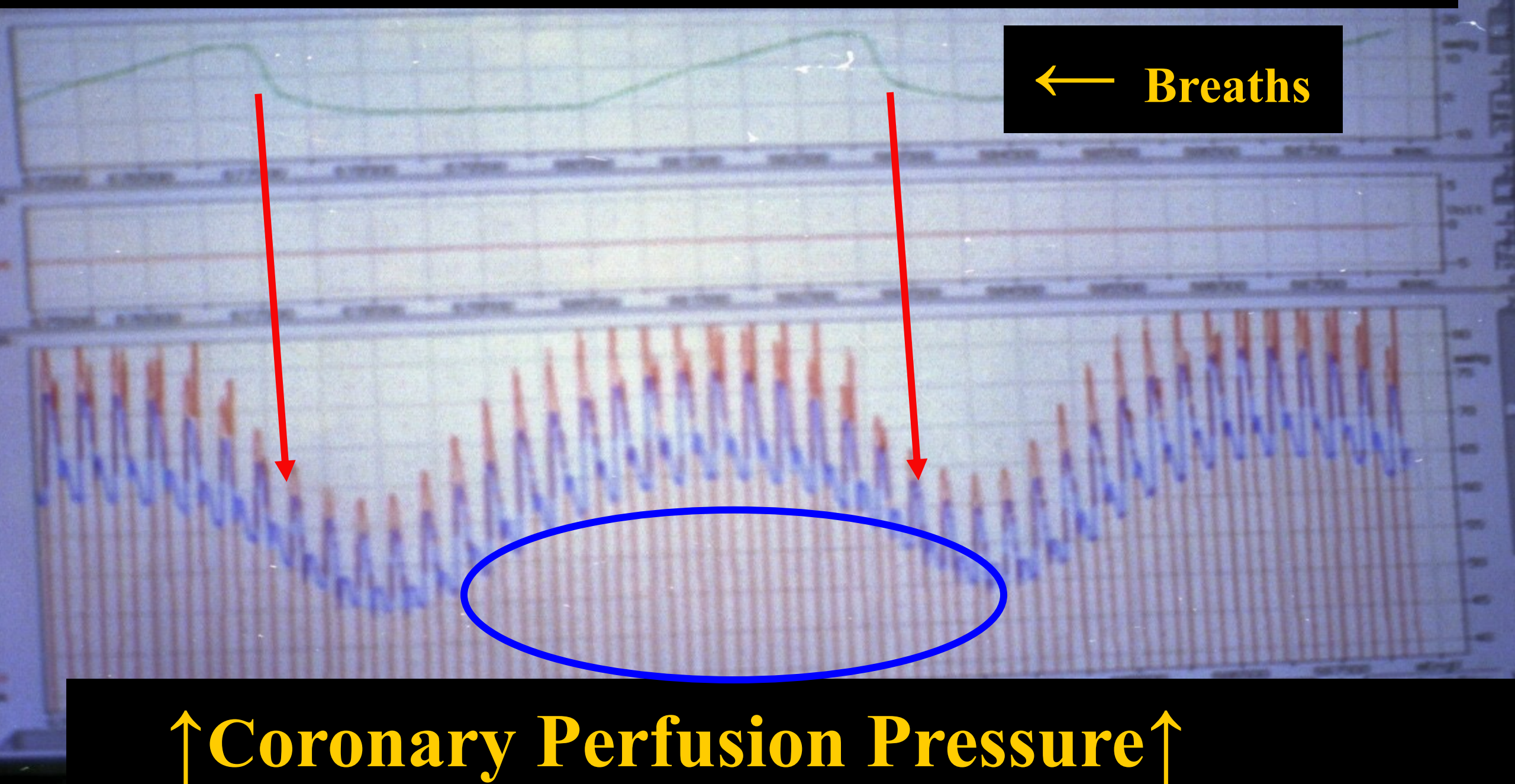




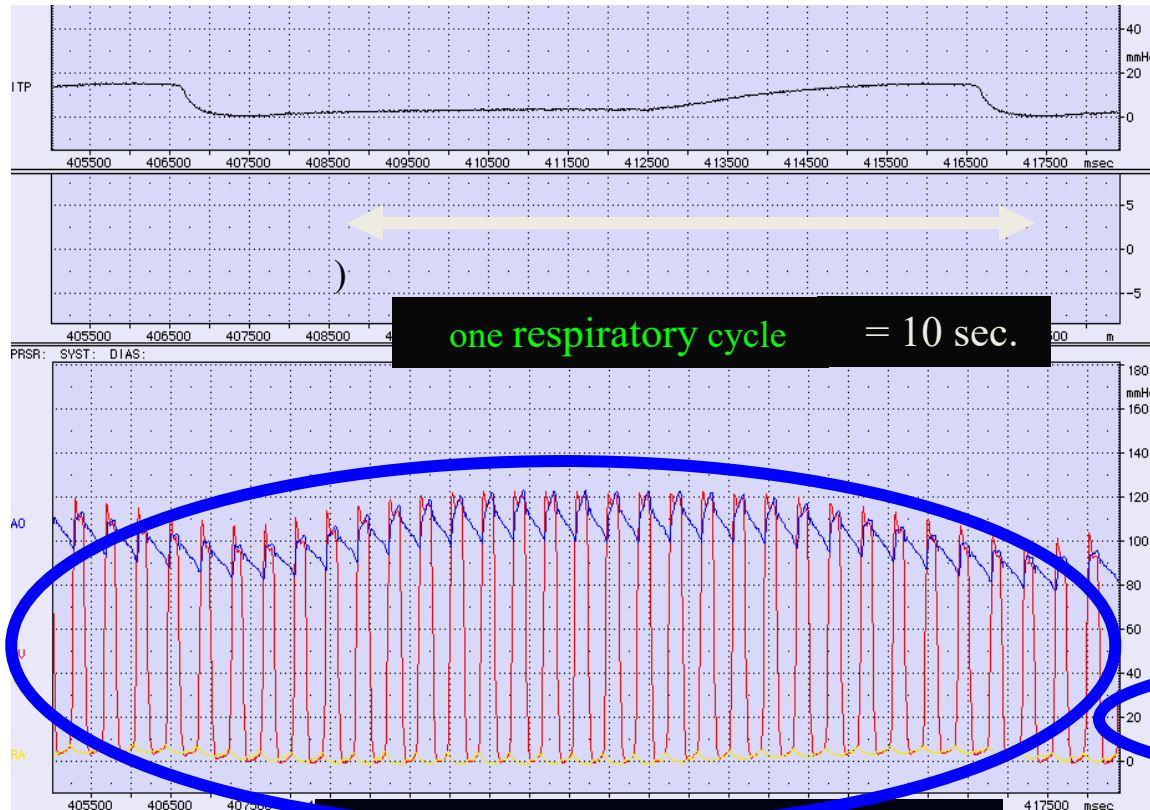
POITIVE PRESSURE VENTILATION FOR THE SHOCKED PATIENT??



Ventilated Pigs with Moderate Hemorrhage



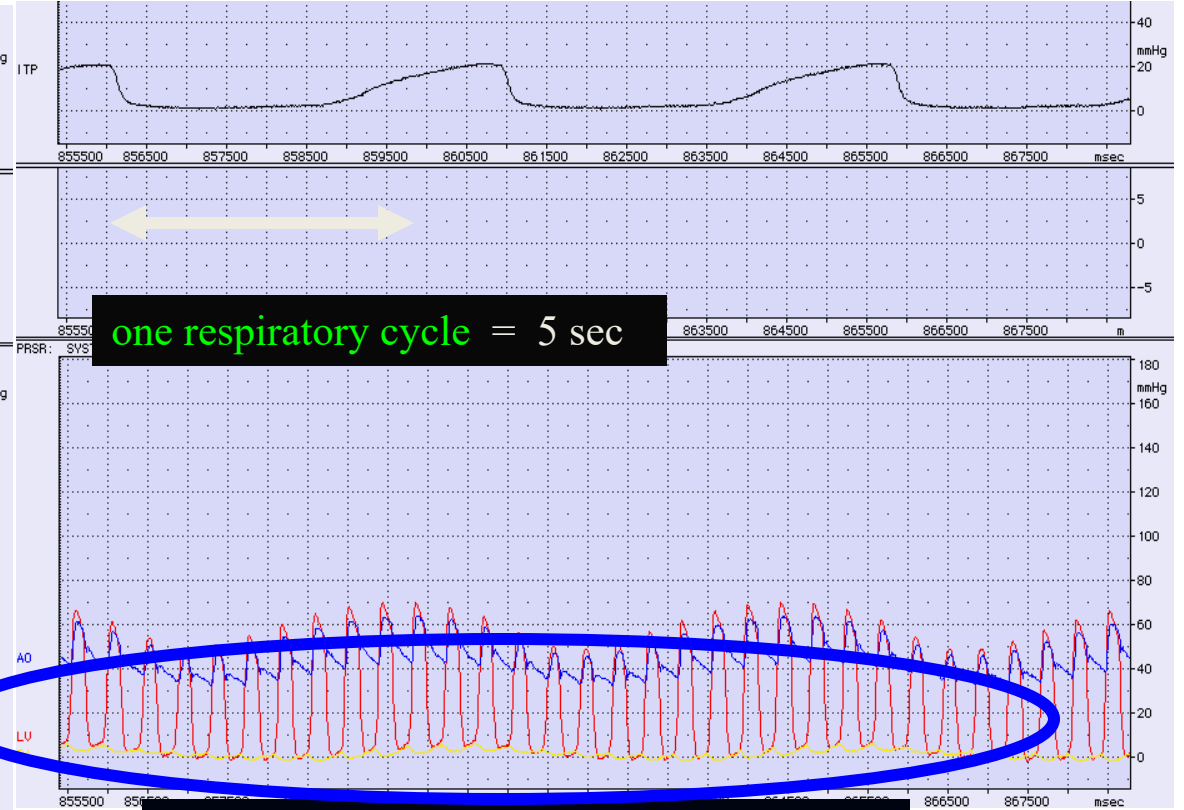
Time-Averaged Coronary Perfusion Pressure = *Area Under the Curve (in Pink)*



one respiratory cycle = 10 sec.

RR = 6 / min

S



one respiratory cycle = 5 sec

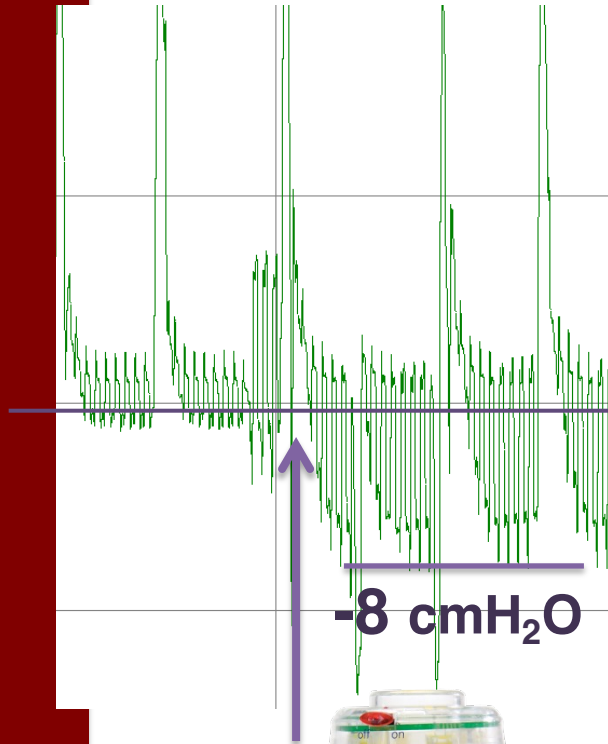
RR = 12 / min



Manipulating Intrathoracic Pressures

(as shown by effect on airway pressure)

CPR

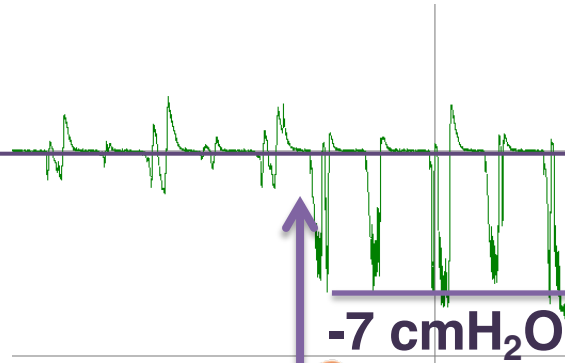


-8 cmH₂O



ResQPOD ITD

Spontaneously Breathing

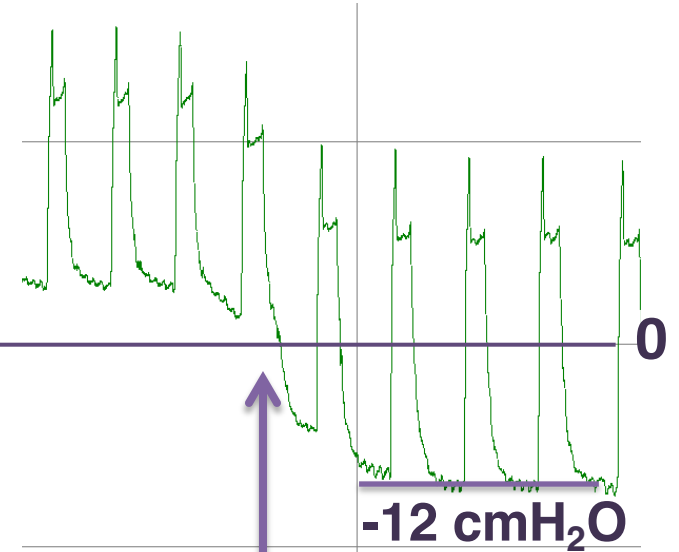


-7 cmH₂O



ResQGARD ITD

Mechanically Ventilated



-12 cmH₂O



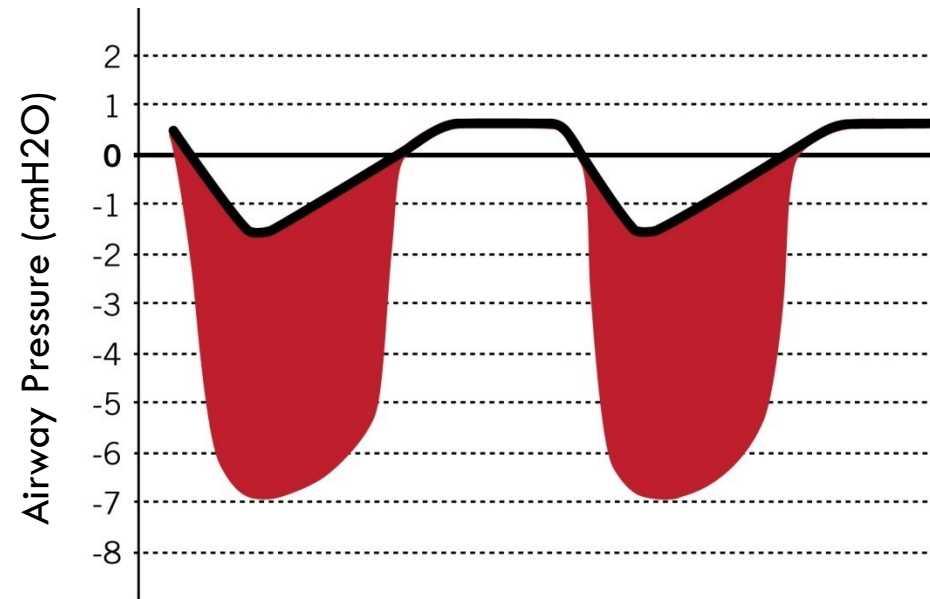
CirQlator ITPR



IPR During Spontaneous Respiration

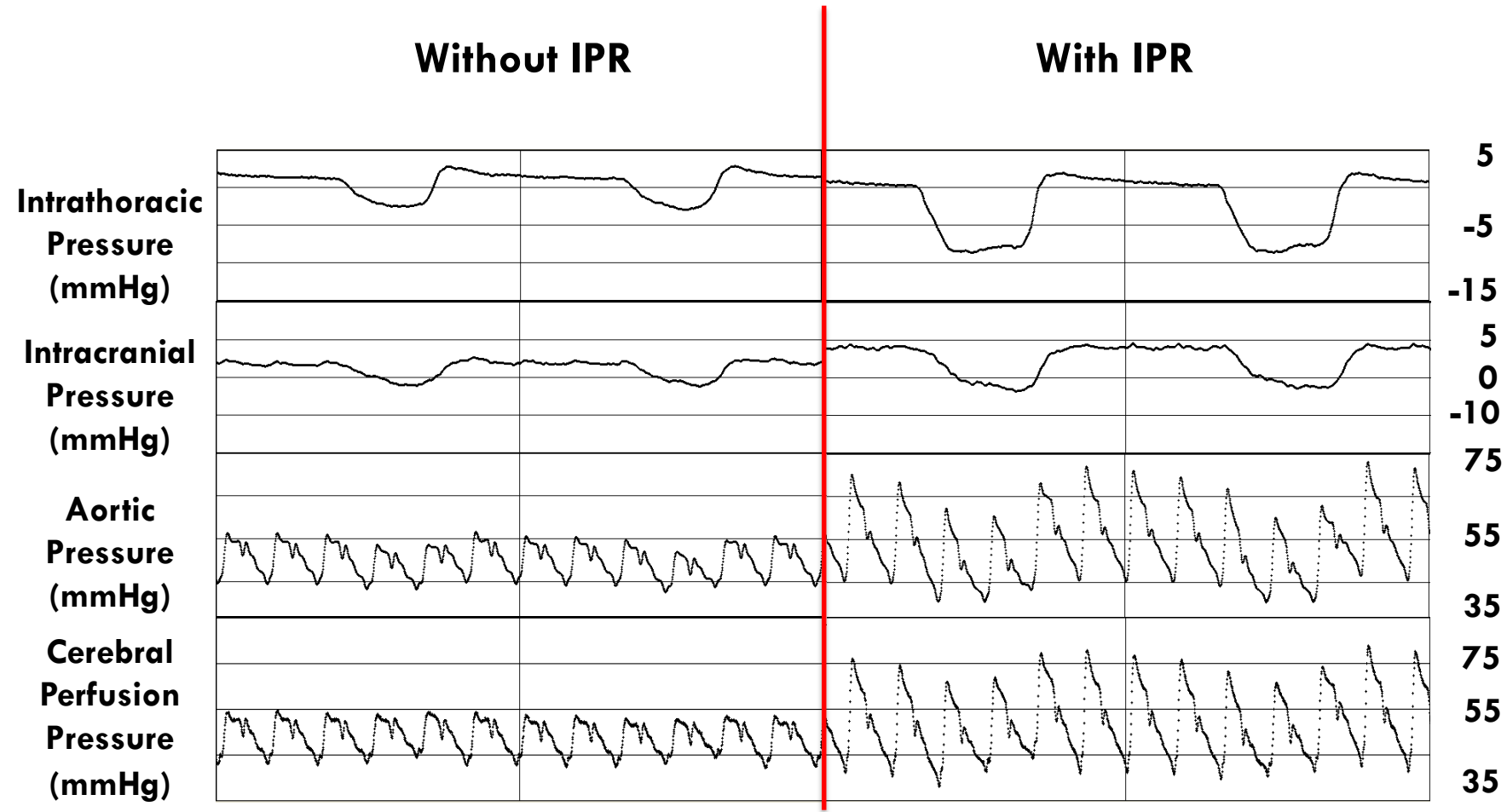
INTRATHORACIC PRESSURE REGULATION

1. Lowers intrathoracic pressure
2. Lowers ICP
3. Refills the heart
4. Increases cerebral and systemic circulation
5. Harnesses the sympathetic nervous system
6. Mimics stress response to central hypovolemia



Spontaneously Breathing Animal

(40% Hemorrhage)



2 Seconds per Division

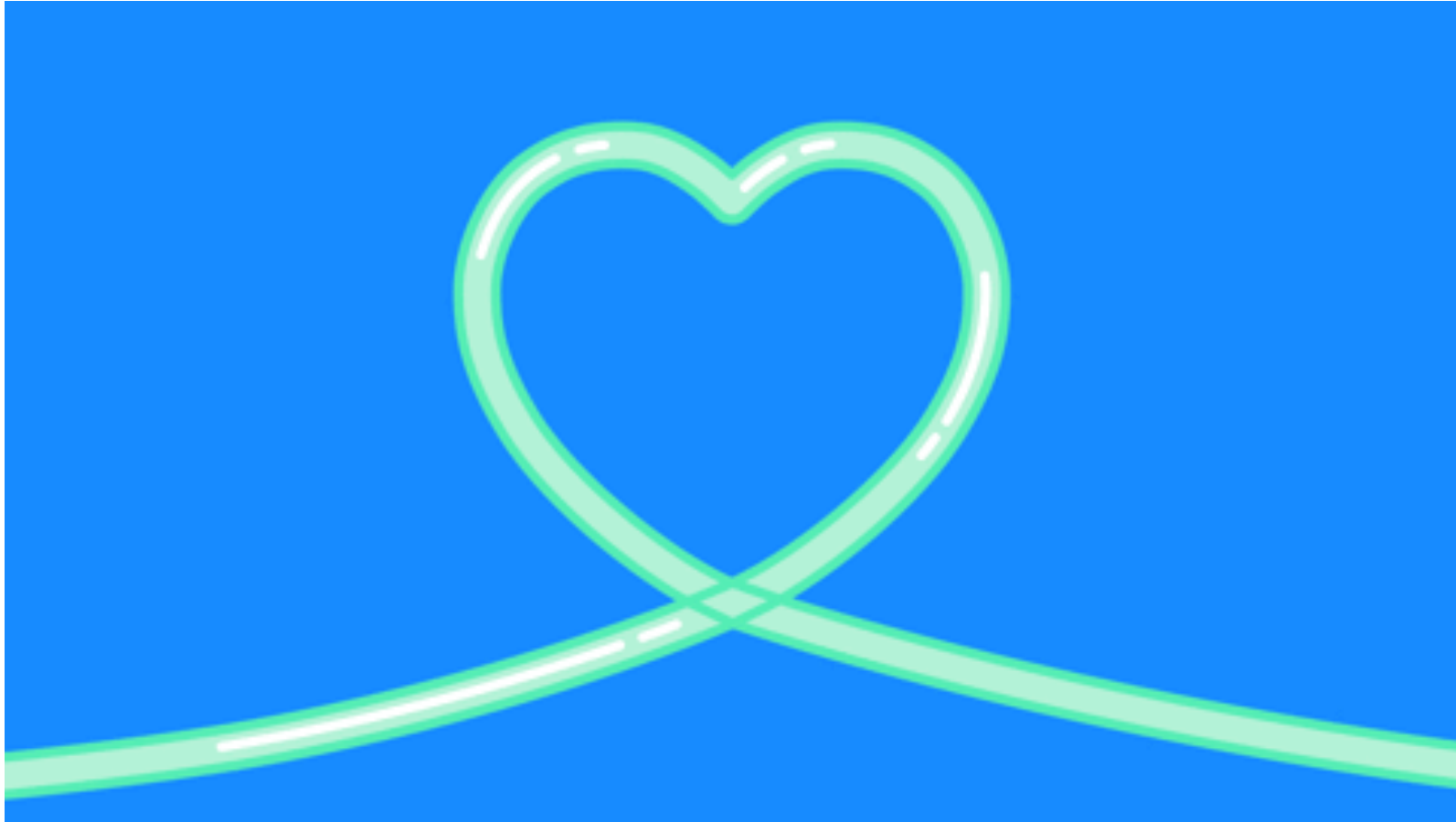


SOMETIMES YOU HAVE TO SECURE THE AIRWAY

- NORMOVENTILATE WHEN IN SHOCK??
- SPONTANEOUS BREATH WHILE INTUBATED?
- V/Q MATTERS??
- WHEN PERFUSION THROUGH THE LUNGS ARE REDUCED DUE TO HYPOVOLEMIA , WHAT IS NORMOVENTILATION ?
- OXYGENATION IS THE KEY
- DONT WORRY ABOUT THE CO2



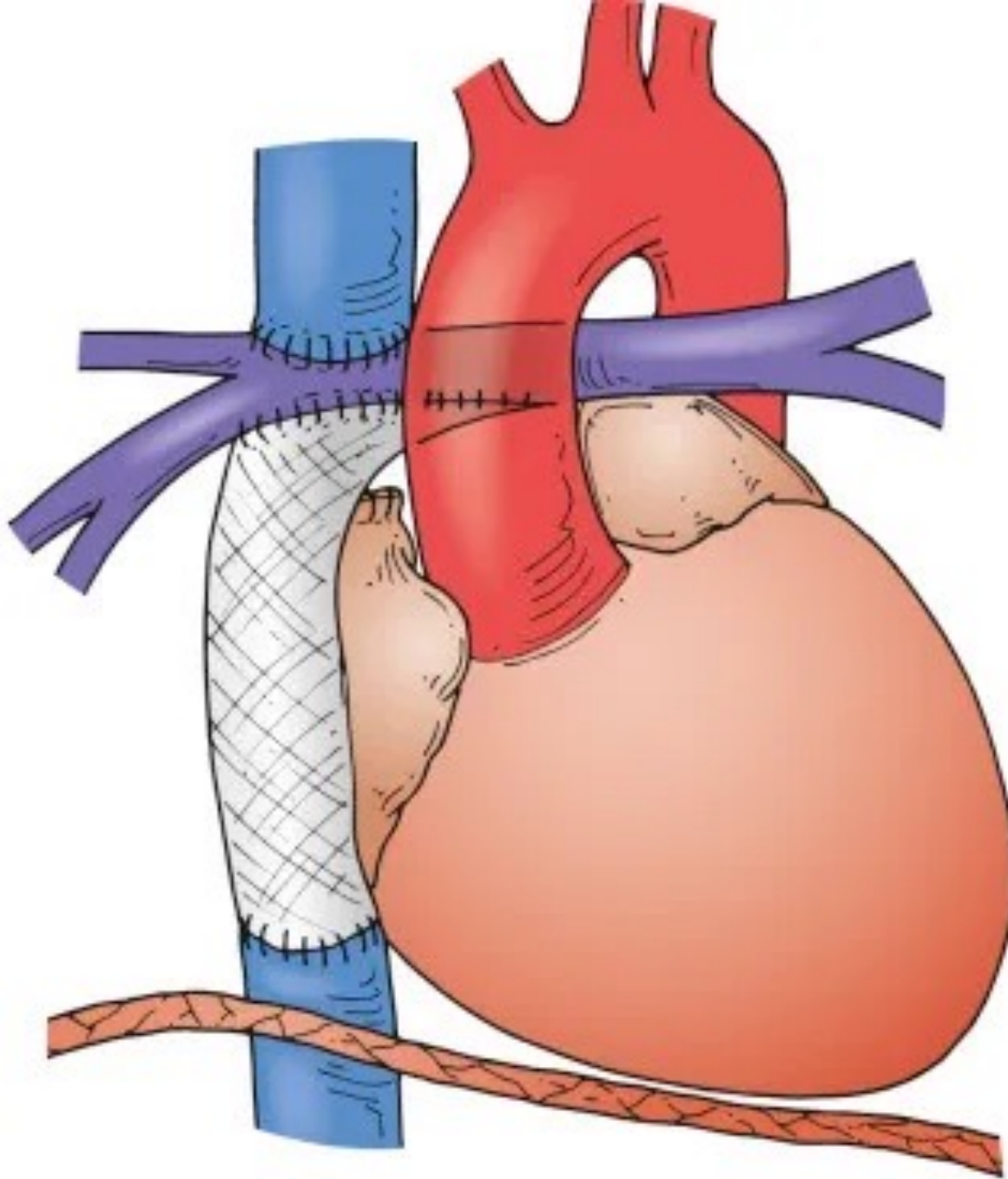
PERFUSE IT OR LOSE IT





GUIDELINE CRITICALLY SHOCKED PATIENT

- DONT DISCONNECT THE HEART LUNG MACHINE
- SPONTANEOUS BREATHING , FACEMASK O2
- POSITIONING - GRAVITY AS AIRWAY MANAGER
- IF VENTILATORY ASSIST: REDUCE RR BY 50%
- APPLY IPR IF POSSIBLE
- TRANSFUSE - Whole Blood group O low titer + diesel + calcium + TXA



"Don't cling to a mistake just because you spent a lot of time making it."

"Everything that needs to be said has already been said. But since no one was listening, everything must be said again."

André Gide

QUESTIONS????