



NORSOCOM
Marinejegerkommandoen



RDCR RECOGNIZING AND TREATING SHOCK





Blood Loss and Shock

Question: How does your body react to blood loss?

Answer: It depends – on how much blood you lose.





Normal Adult Blood Volume 5 Liters





NORSOCOM
Marinejegerkommandoen

500cc Blood Loss

4.5 Liters Blood Volume





500cc Blood Loss

- Mental State: Alert
- Radial Pulse: Full
- Heart Rate: Normal or slightly increased
- Systolic Blood pressure: Normal
- Respiratory Rate: Normal
- Is the casualty going to die from this?

No





NORSOCOM
Marinejegerkommandoen

1000cc Blood Loss

4.0 Liters Blood Volume





1000cc Blood Loss

- Mental State: Alert
- Radial Pulse: Full
- Heart Rate: 100 +
- Systolic Blood pressure: Normal lying down
- Respiratory Rate: May be normal
- Is the casualty going to die from this?

No





NORSOCOM
Marinejegerkommandoen

1500cc Blood Loss





1500cc Blood Loss

- Mental State: Alert but anxious
- Radial Pulse: May be weak
- Heart Rate: 100+
- Systolic Blood pressure: May be decreased
- Respiratory Rate: 30
- Is the casualty going to die from this?

Probably not





2000cc Blood Loss

3.0 Liters Blood Volume





2000cc Blood Loss

- Mental State: Confused/lethargic
- Radial Pulse: Weak
- Heart Rate: 120 +
- Systolic Blood pressure: Decreased
- Respiratory Rate: >35
- Is the casualty going to die from this?

Maybe





NORSOCOM
Marinejegerkommandoen

2500cc Blood Loss

2.5 Liters Blood Volume





2500cc Blood Loss

- Mental State: Maybe unconscious
- Radial Pulse: Absent
- Heart Rate: 140+
- Systolic Blood pressure: Markedly decreased
- Respiratory Rate: Over 35
- Is he going to die from this?

Probably





Recognition of Shock on the battlefield

- Combat medical personnel need a fast, reliable, low-tech way to recognize shock on the battlefield.
- **The best TACTICAL indicators of shock are:**
 - Mechanism of injury compatible with shock
 - Decreased state of consciousness (if casualty has not suffered TBI) and/or
 - Abnormal character of the radial pulse (weak or absent)





Identifying the patient

- Vital signs?
- Systolic blood pressure?
 - Surrogate for cellular perfusion?
 - Undertriage 0-5%
 - Overtriage 15-50%
- Lacks sensitivity/specificity for predicting patient outcomes and the need for resuscitative care
- **MECHANISM OF INJURY!!!**

Vandromme, Marianne J., et al. "Lactate is a better predictor than systolic blood pressure for determining blood requirement and mortality: could prehospital measures improve trauma triage?." *Journal of the American College of Surgeons* 210.5 (2010): 861-867.

McCue S, Abernethy WB 3rd, Simel DL. The rational clinical examination. Is this patient hypovolemic? *JAMA*. 1999;281(11):1022-1029.

Brasel KJ, Guse C, Gentilello LM, Nirula R. Heart rate: is it truly a vital sign? *J Trauma*. 2007;62(4):812-817.

Bulger EM, Jurkovich GJ, Nathens AB, Copass MK, Hanson S, Cooper C, Liu PY, Neff M, Awan AB, Warner K, Maier RV. Hypertonic resuscitation of hypovolemic shock after blunt trauma: a randomized controlled trial. *Arch Surg*. 2008;143(2):139-148; discussion 149.

Newgard CD, Rudser K, Hedges JR, Kerby JD, Stiell IG, Davis DP, Morrison LJ, Bulger E, Terndrup T, Minei JP, et al. A critical assessment of the out-of-hospital trauma triage guidelines for physiologic abnormality. *J Trauma*. 2010;68(2):452-462.





Point of care lactate

- Elevated lactate is predictive of poor outcomes in the in-hospital setting
- P-LAC is superior to other early surrogates for hypoperfusion (SBP and shock index) in predicting the need for RC in trauma patients with $70 \text{ mm Hg} < \text{SBP} < 100 \text{ mm Hg}$
- Trends associated with the effectiveness of resuscitation, even with normal vital signs

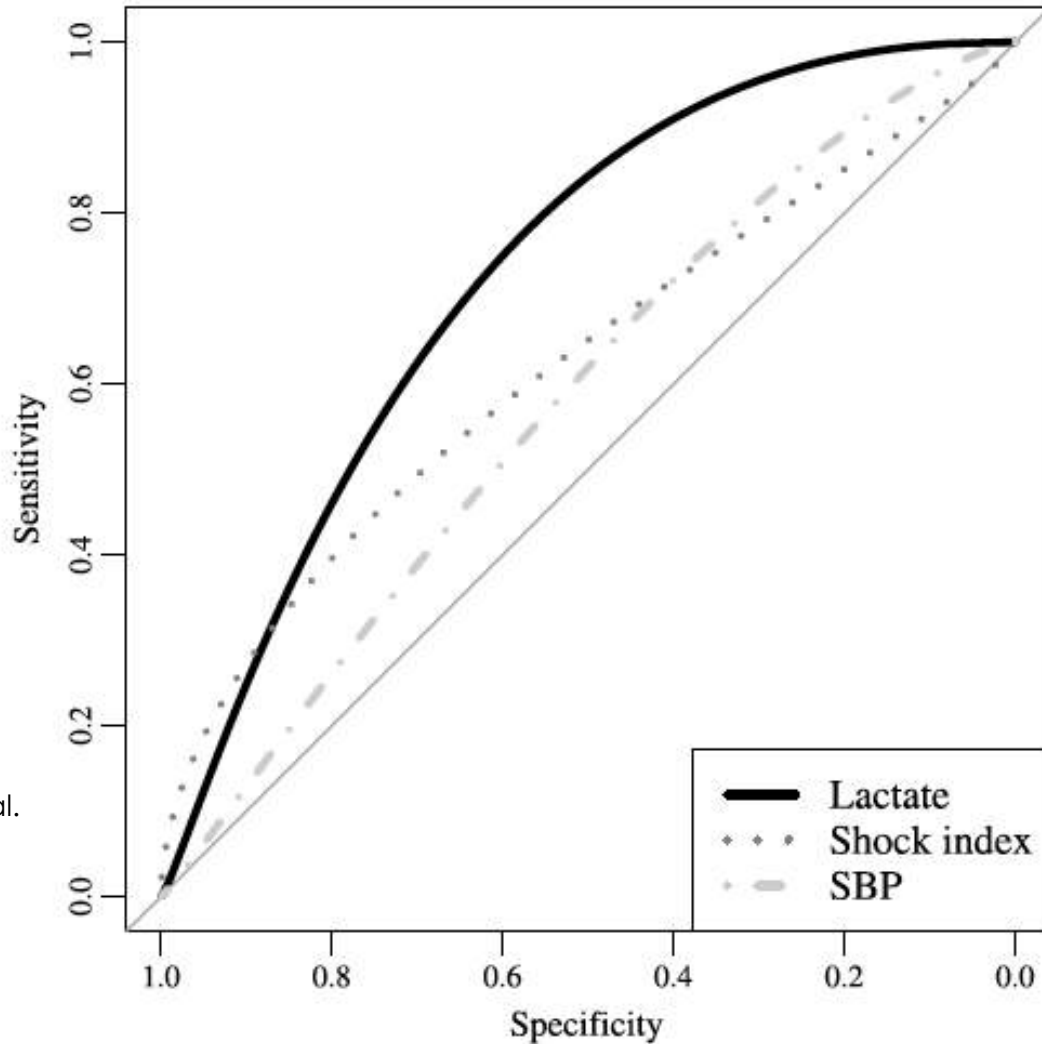
Guyette, Francis X., et al. "A comparison of prehospital lactate and systolic blood pressure for predicting the need for resuscitative care in trauma transported by ground." *Journal of Trauma and Acute Care Surgery* 78.3 (2015): 600-606.





Sensitivity/Specificity

SBP >70
SBP <100

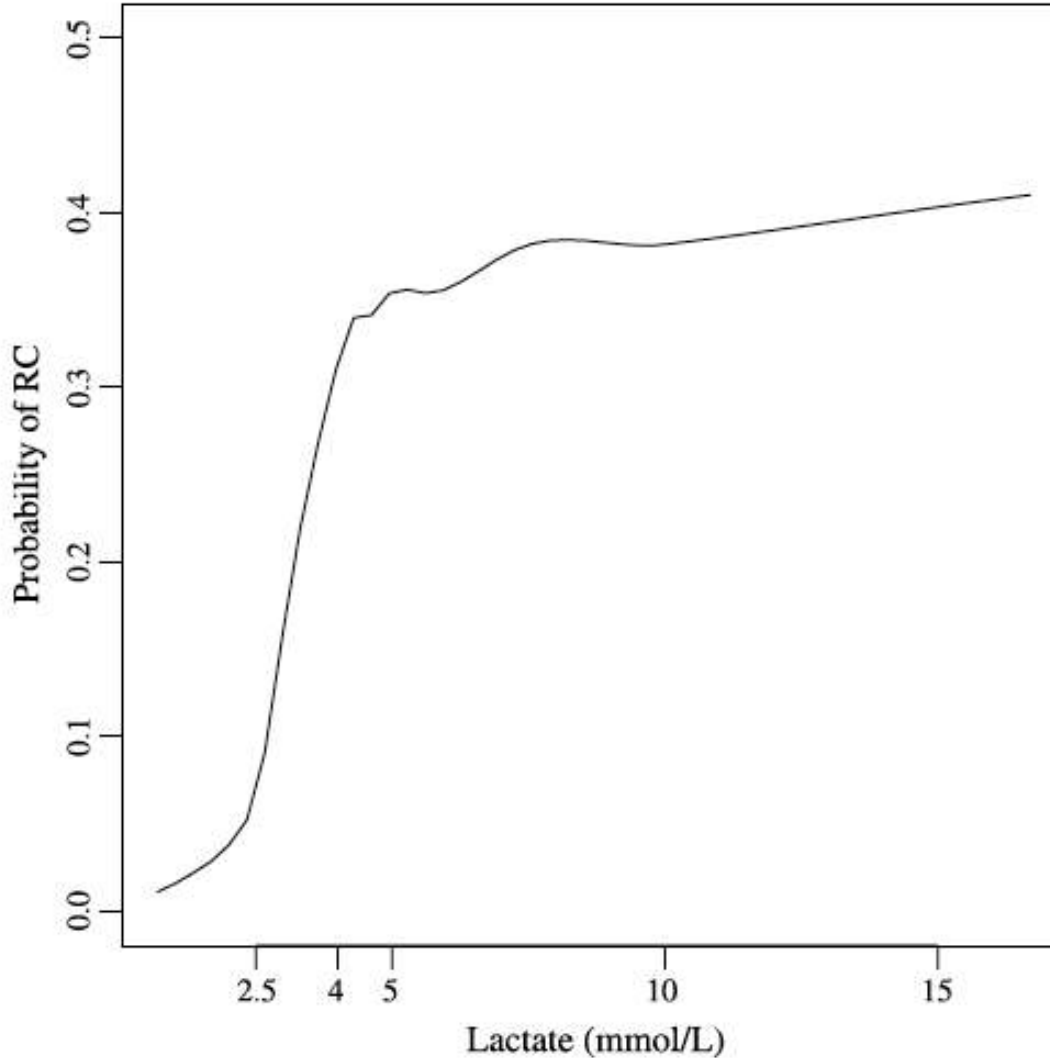


Guyette, Francis X., et al.





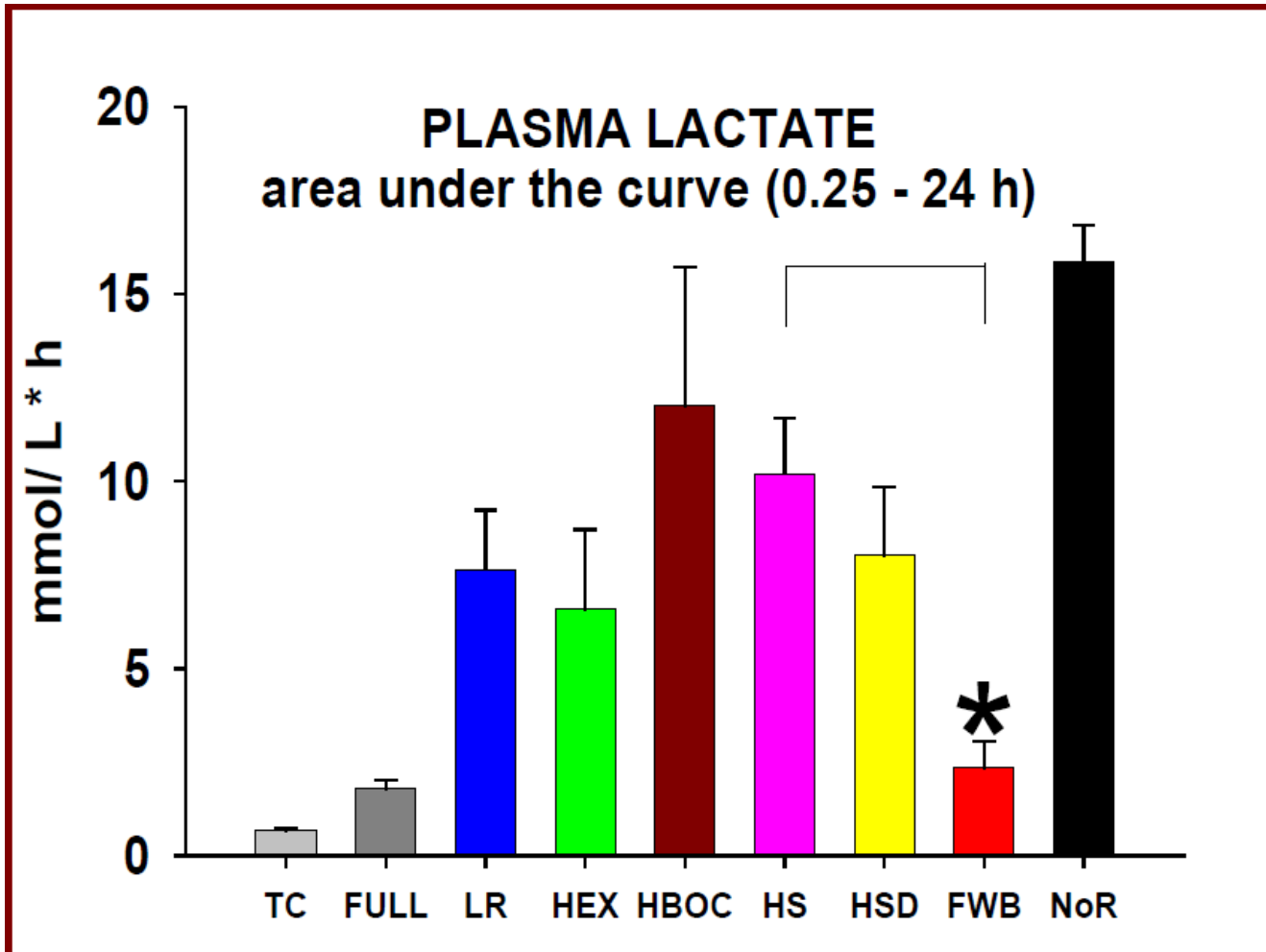
Probability of resuscitative





Lactate and resuscitation

Dubick et al. ISR
In preparation
2016





The detrimental effects of positive pressure ventilation during low-flow states

- Ventilatory requirements during low flow states is limited
- Positive pressure ventilation impairs perfusion

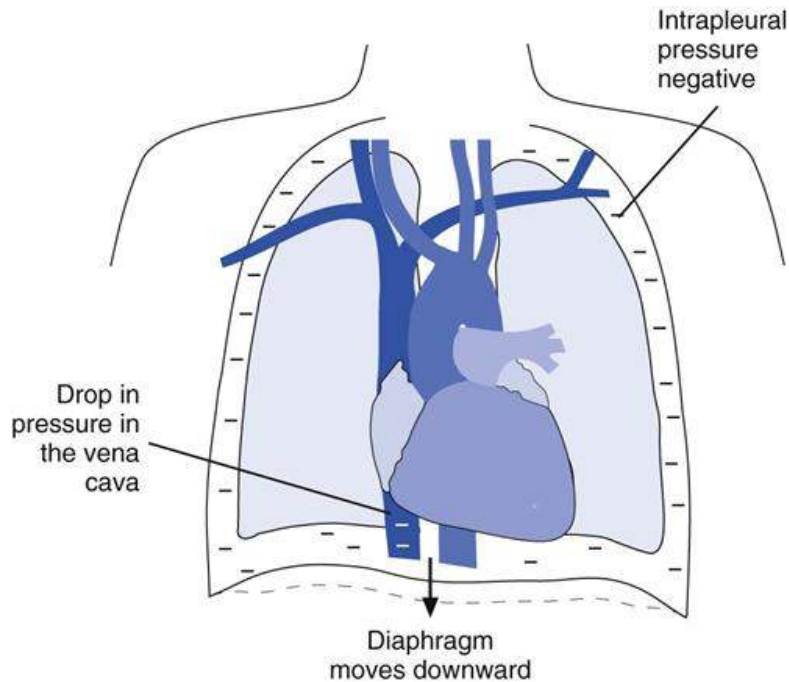
Pepe, Paul E., Lynn P. Roppolo, and Raymond L. Fowler. "The detrimental effects of ventilation during low-blood-flow states." *Current opinion in critical care* 11.3 (2005): 212-218.



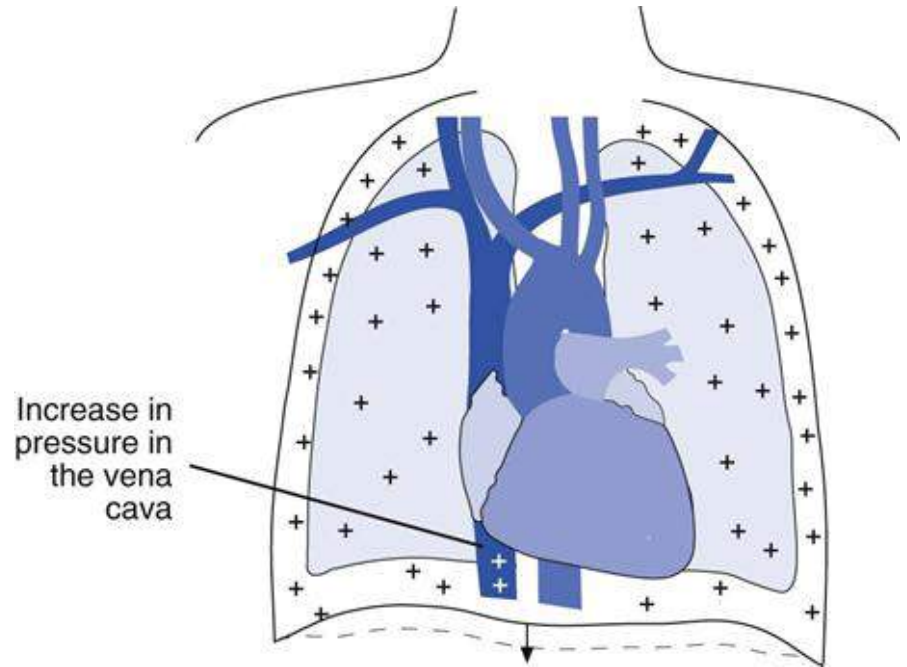


Positive pressure ventilation

In order for blood to enter the thoracic cavity, the intrathoracic pressure needs to be low



Spontaneous breathing



Positive pressure ventilation

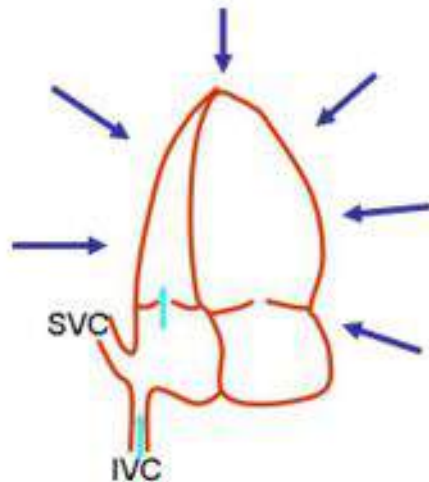




Positive pressure ventilation

INSUFFLATION

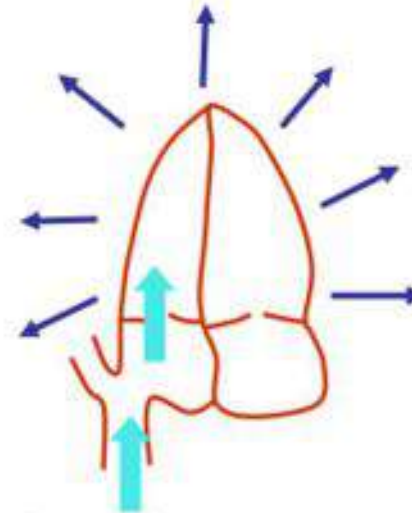
Increased intra-thoracic pressure



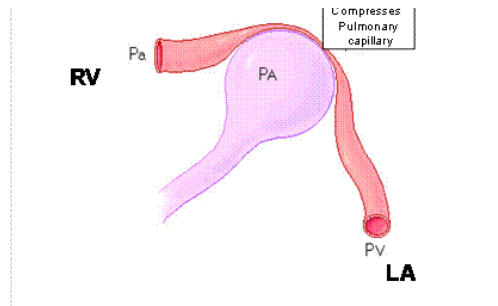
Decreased venous return

EXPIRATION

Decreased intra-thoracic pressure



Increased venous return





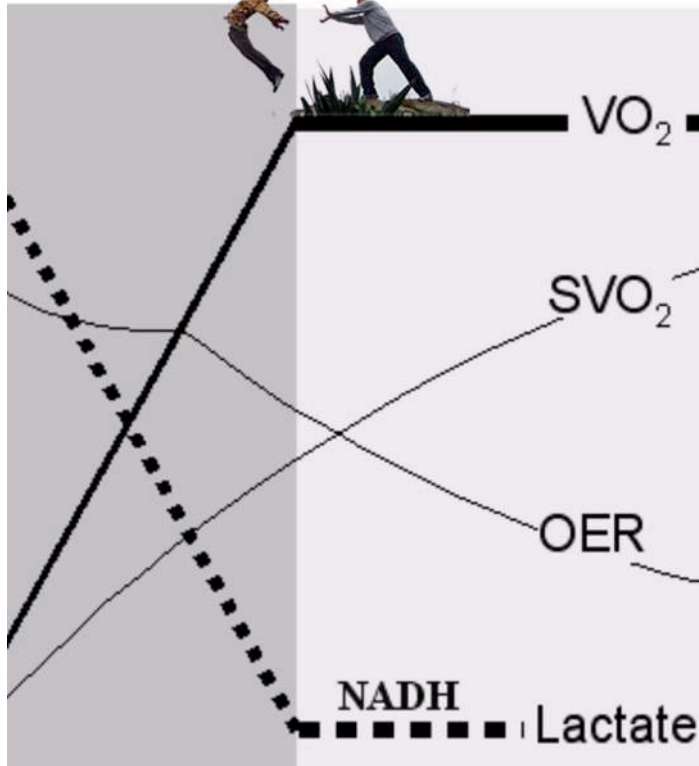
NORSOCOM
Marinejegerkommandoen

Keep the patient spontaneous
breathing!!!





Do not mess with the compensatory mechanisms!!!



Pento



Sux

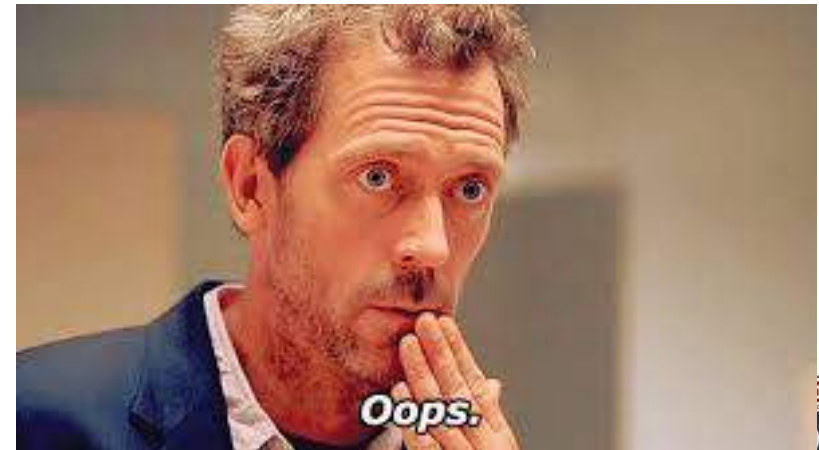


Intubation



CPR

R.Dutton





Compensatory mechanisms

- Is pain a problem in profound shock?
 - You must reduce the dose of analgetics/ anaesthetics significantly!!!
 - Consider not give anything at all
 - Survival comes with a price!
- Keep the patient spontaneously breathing!!
 - Be a world champion in positioning and simple airway management





Hypothermia Prevention

- **Key Point: Even a small decrease in body temperature can interfere with blood clotting and increase the risk of bleeding to death.**
- Casualties in shock are unable to generate body heat effectively.
- Wet clothes and helicopter evacuations increase body heat loss.
- Remove wet clothes and cover casualty with hypothermia prevention gear.
- **Hypothermia is much easier to prevent than to treat!**





Endpoints of resuscitation

- Two scenarios:
 - Compressible bleeding - The patient has bled - the bleeding has stopped
 - Non - compressible bleeding - The patient is actively bleeding





Compressible bleeding - The patient has bled – the bleeding has stopped

- Resuscitate towards normal vital signs
- Aggressive monitoring
- Reoccurrence of shock symptoms – continue with permissive hypotension





Non – compressible bleeding – The patient is actively bleeding

- Resuscitate to improved mental status and/or radial pulse.
- Consider using point of care lactate trends
- Consider bringing a blood pressure cuff
- “Go with gravity”
- Avoid hypothermia
- Rapid evacuation
- Transfusion protocol must not delay evacuation





Best treatment for Hemorrhage/ Shock/ATC?

What we are doing now that is associated with improved outcomes?

- Aggressive hemorrhage control
 - Hemostatic dressings, tourniquets
 - TXA
- Early resuscitation that delivers **functionality of WB** (WB or 1:1:1)
 - Increasing use of plt & cryo (1:1:1:1)
 - ROTEM-guided DCR?
 - Permissive hypotension?
- Reduced crystalloid/colloid
- Minimize time to surgery

