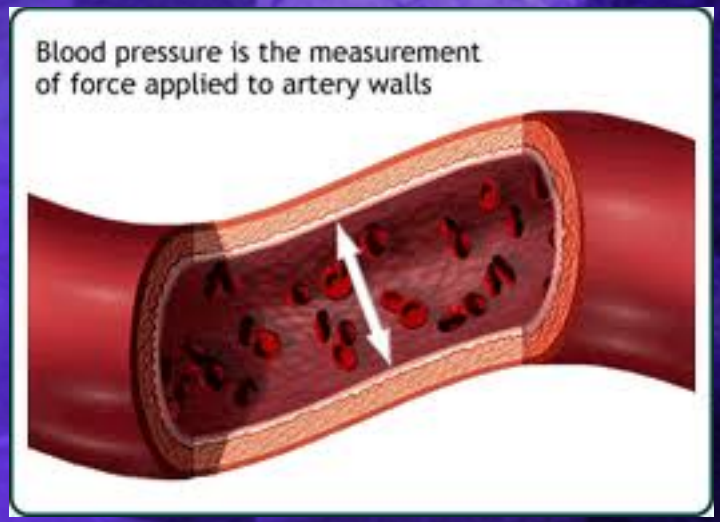
Taking the Pressure Off

Hypotensive Resuscitation in Traumatic Injuries

Jeff Beeson, DO, FACEP, EMT-P
Fort Worth, TX

Blood Pressure

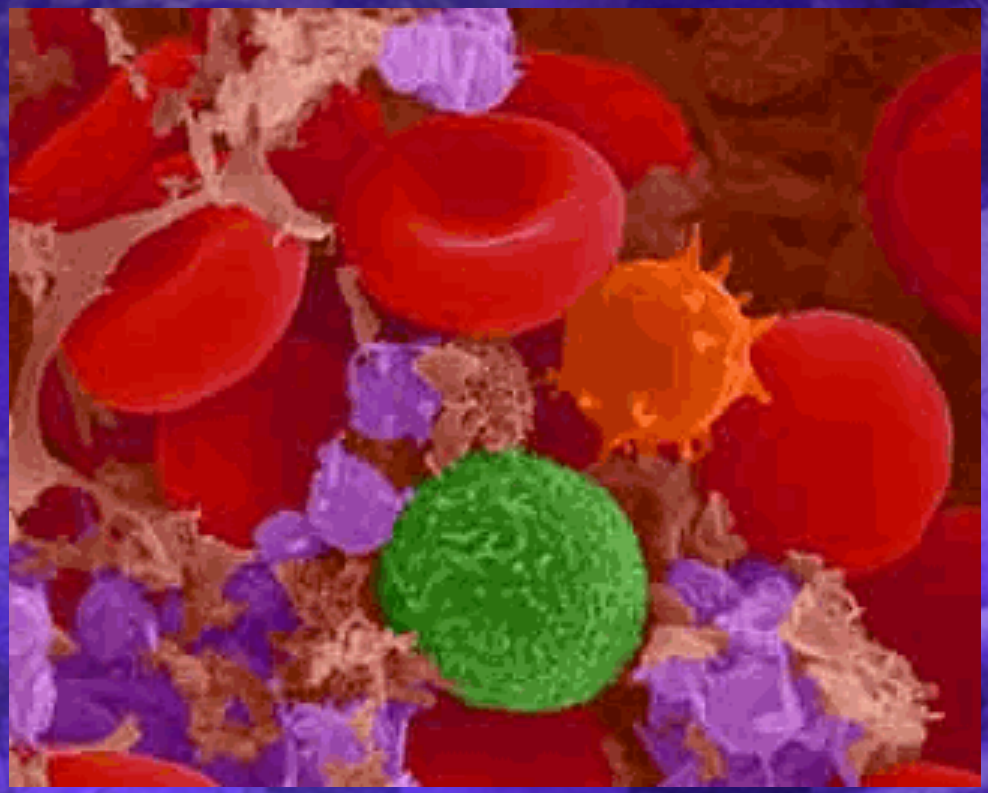
- Arterial blood pressure is the pressure exerted by the moving blood on the walls of the blood vessels.
- Effected by:
  - Rate
  - Volume
  - Resistance
  - Viscosity



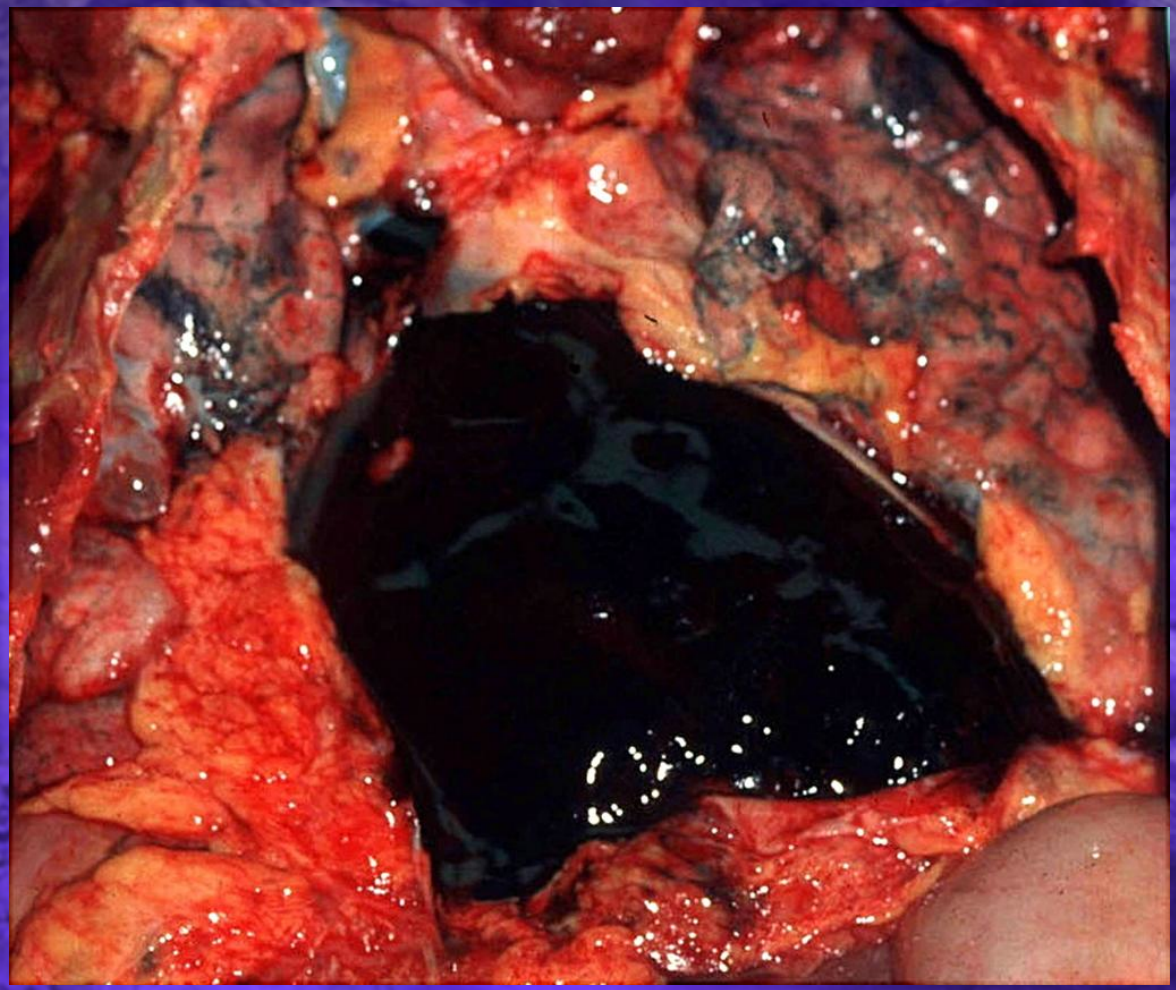
How do we measure BP?

Blood

Clot Formation



Blood Clot



While there is still a hole in a named blood vessel, what is the *best fluid resuscitation strategy* to keep the victim alive until hemostasis can be achieved, and to promote intact survival?

History of Saline in Resuscitation

- Cholera pandemic of 1831
- Saline Injections
- O'Saughnessy
  - Lancet publication
  - Victim's blood "lost a large portion of its water"
  - Return blood to its "natural specific gravity" and "replace its deficient saline"

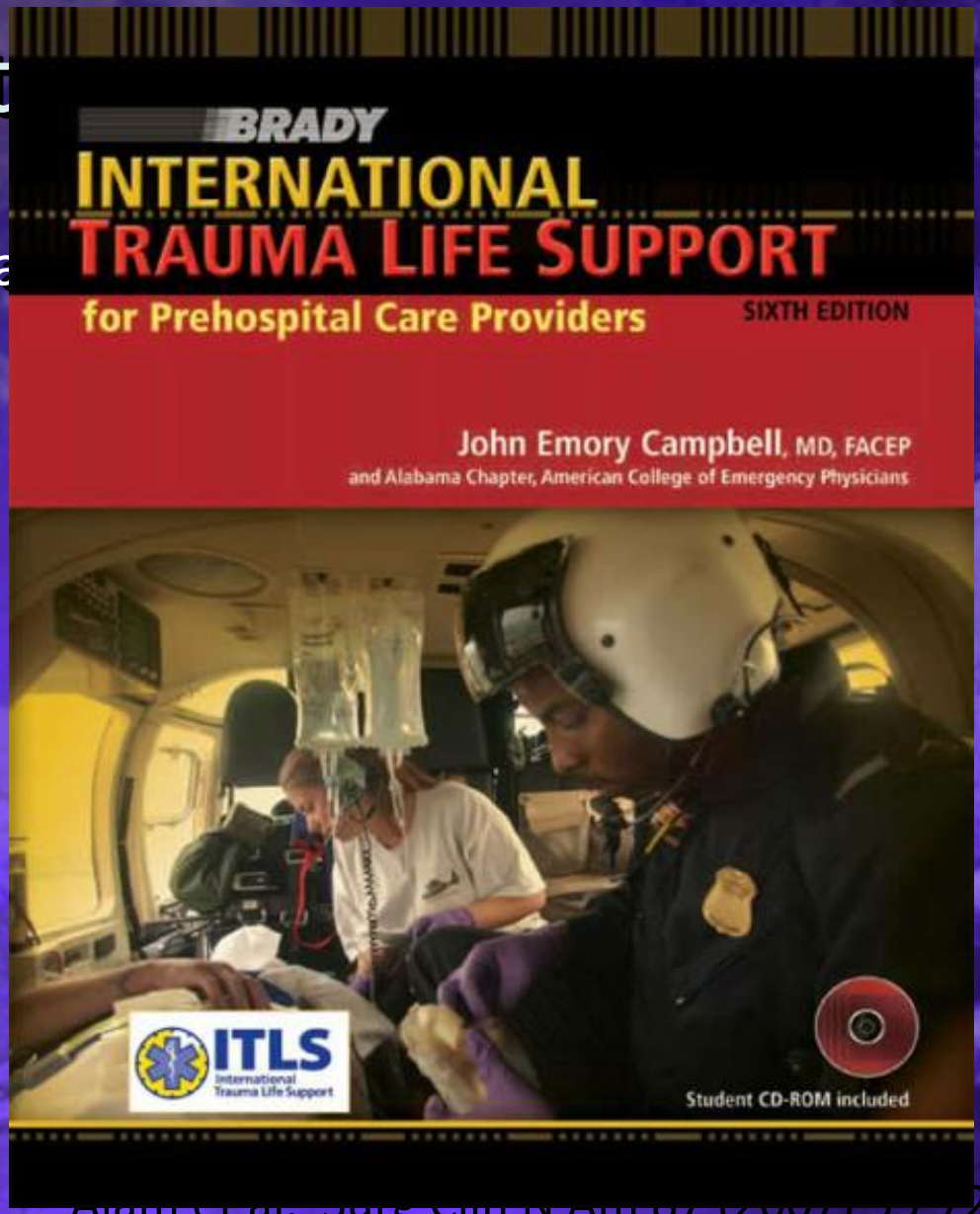
New Developments in Fluid Resuscitation

- Vietnam War era (Shires, Moyer, Moss)
  - Aggressive crystalloid resuscitation
  - 3:1 Replacement (as high as 8:1 for significant shock)
- Intensive Care (Shoemaker)
  - Oxygen debt
  - "Maximizing or supernormalizing" Cardiac Output

Alam et al. Surg Clin N Am 87 (2007) 55-72

ATLS Set

- ATLS ba



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Science?

Effect of Blood Pressure on Hemorrhage Volume

- Surgically created hemorrhage
- Stepwise increase in blood pressure with aggressive crystalloid resuscitation
  - MAP 40, 60, 80 mmHg

Conclusions:

Attempts to restore blood pressure with crystalloids resulted in increase hemorrhage volume and higher mortality

Stern et al. Ann Emerg Med 22(2):155-63 Feb 1993

Houston Trial:
Delayed Fluid Resuscitation

- 598 adults
- Penetrating injuries
  - SBP <90 mmHg
- Randomized by odd or even day
- Improved survival in delayed resuscitation

Bickell, Pepe, et al. *NEJM*, 1994

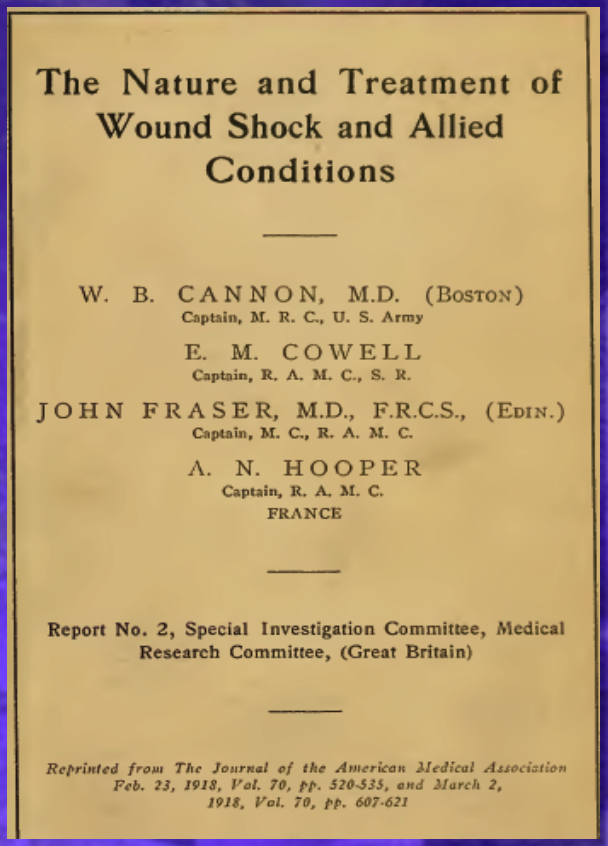
Blood Pressure at which Rebleeding Occurs

- Surgically created hemorrhage
  - Aortotomy
  - Resuscitation at 5, 15, 30 minutes
  - Rebleeding MAP 64, Systolic 94

Sondeen et al. Journal of Trauma May 2003, S110 - 117


Is Permissive Hypotension:
A New Concept?

The Nature and Treatment of Wound Shock and Allied Conditions



The Nature and Treatment of Wound Shock and Allied Conditions

W. B. CANNON, M.D. (BOSTON)
Captain, M. R. C., U. S. Army

E. M. COWELL
Captain, R. A. M. C., S. R.

JOHN FRASER, M.D., F.R.C.S., (EDIN.)
Captain, M. C., R. A. M. C.

A. N. HOOPER
Captain, R. A. M. C.
FRANCE

Report No. 2, Special Investigation Committee, Medical Research Committee, (Great Britain)

Reprinted from The Journal of the American Medical Association Feb. 23, 1918, Vol. 70, pp. 520-535, and March 2, 1918, Vol. 70, pp. 607-621

Cannon et al. JAMA (1918) 607-21

Tactical Combat Casualty Care

Despite widespread use, the benefit of prehospital fluid resuscitation in trauma has not been established

- 22 references

Tactical Combat Casualty Care

Animal data clearly establishes aggressive fluid resuscitation in unrepaired vascular injury is either of no benefit or results in an increase in blood loss and mortality

- 18 references

Tactical Combat Casualty Care

Two Studies were found to suggest fluid resuscitation may be of benefit in uncontrolled hemorrhage

- Rat-tail amputation
- 2 references

Crystalloids cannot replace lost blood and only serves to dilute what's left.

Resuscitation Outcomes Consortium

Subject Selection

Inclusion Criteria

- Blunt or penetrating injury
- Prehospital SBP ≤90 mmHg
- Age ≥15 y/o
  - Or ≥50 kg, if age unknown
- Absence of severe head injury
  - Or GCS >8

Exclusion Criteria

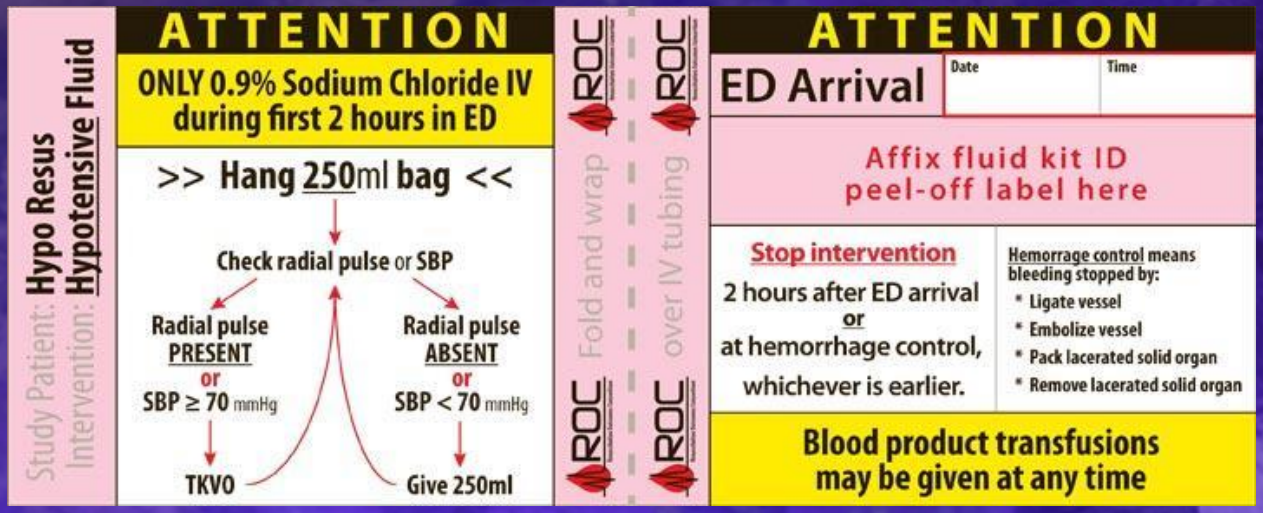
- Severe head injury with GCS ≤8
- >250 ml intravenous fluid given*
- Any CPR by First Responders
- Known prisoners
- Known/suspected pregnancy
- Drowning or hanging
- Burns >20% TBSA
- Time from dispatch >4 hrs
- Prehospital SBP >90 mmHg
- Age <15
  - Or <50 kg, if age unknown

**Patient can receive up to 250 ml of fluid and still be eligible for enrollment.*

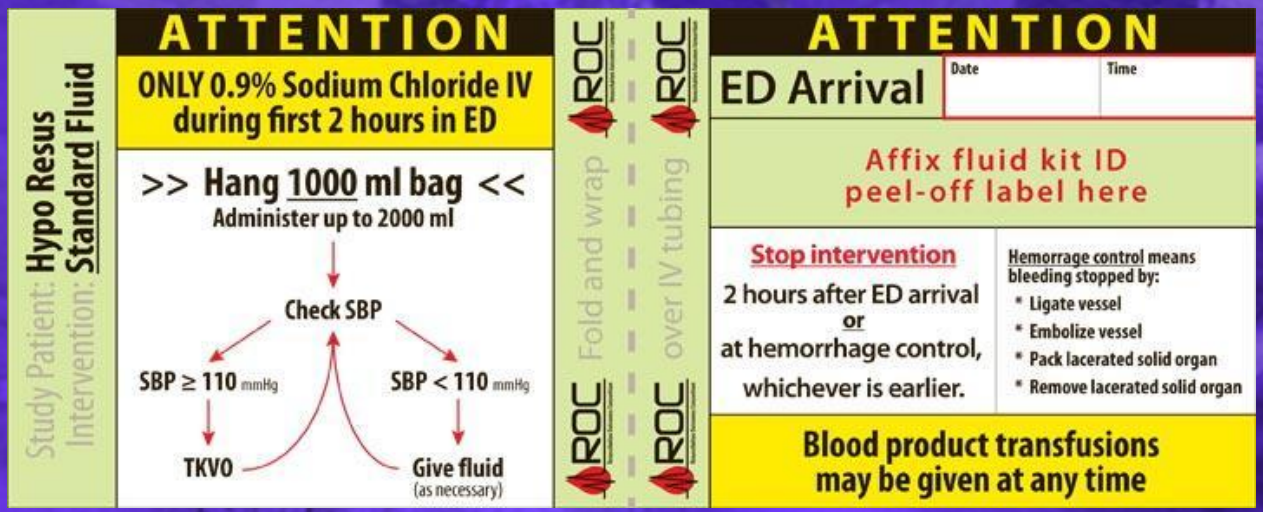
Study Fluids

Box will contain either 1 x 1000 ml saline **or** 2 x 250 ml + dummy weight

Labels



Hypotensive Fluid

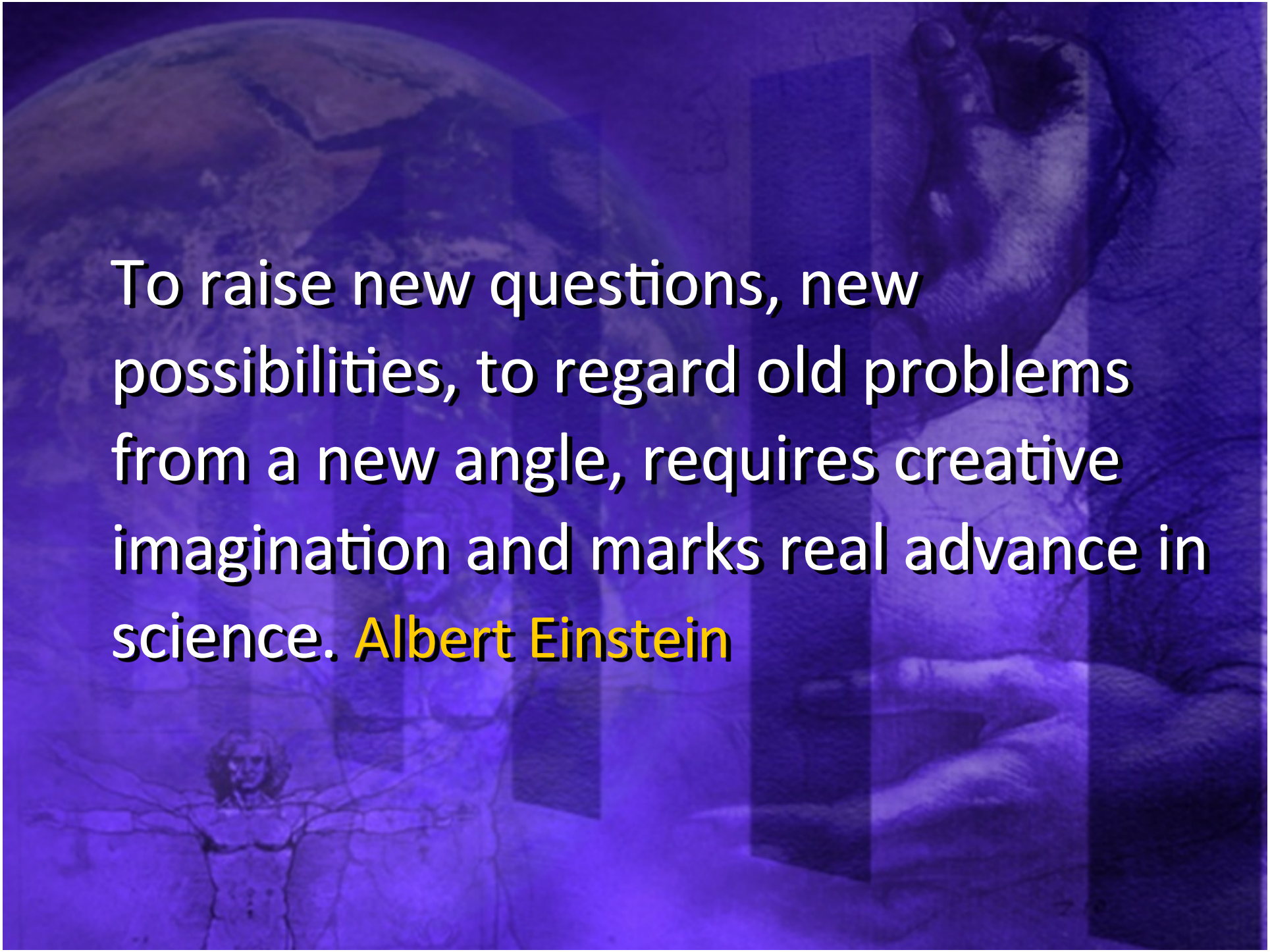


Standard Fluid

Chasing Numbers…

What else can we use?

- Prehospital Lactate Measurements
- BLAST study


To raise new questions, new possibilities, to regard old problems from a new angle, requires creative imagination and marks real advance in science. Albert Einstein