FLUIDS

ASHER BRAND, MD

MEAN ARTERIAL PRESSURE

- **MAP = DBP + 1/3(SBP-DBP)**
- **One third the distance between the diastolic and systolic pressure**
- **120/80 would be:**
  - MAP = 80 + 1/3(120-80)
  - = 80 + 1/3 (40)
  - = 80 + 13
  - MAP = 93

TRAUMA

Two liters Wide!

RESUSCITATION STRATEGIES – NO TBI

- **2 liters then blood**
- **Permissive hypotension**
  - (Damage Control Approach)
- **Colloid**
- **Hypertonic Saline**
- **1:1:1 Transfusion**
- **Plasma**

Target MAP?

2 LITERS WIDE

- **No supporting data**
- **Tradition**
- **May be harmful**
  - Coagulopathy
  - Hypothermia
  - Increased hemorrhage due to  MAP
  - Acid/Base disturbance with massive fluids

Emergency Department Crystalloid Resuscitation of 1.5 L or More is Associated With Increased Mortality in Elderly and Nonelderly Trauma Patients

Ley, Eric J. MD; Clond, Morgan A. PhD; Srour, Marissa K. BS; Barnajian, Moshe MD; Mirocha, James MS; Margulies, Dan R. MD; Salim, Ali MD

- **Retrospective**
- **3,137 pts**
- **Infusion of > 1.5 liters associated with increased mortality**
- **Infusion of < 1.0 liters no difference**

Aggressive early crystalloid resuscitation adversely affects outcomes in adult blunt trauma patients: an analysis of the Glue Grant database.

Kasotakis G, Sideris A, Yang Y, de Moya M, Alam H, King DR, Tompkins R, Velmahos G; Inflammation and Host Response to Injury nvestigators.

Division of Trauma, Emergency Surgery, and Critical Care, Massachusetts General Hospital, Boston, Massachusetts 02114, USA. gkasotakis@mail.harvard.edu

- **Retrospective data base mining**
- **1754 pts**
- **No change for In Hospital Death**
- **Marked increase in morbidity**
  - ICU days, organ failure, ARDS, etc…

Injury, Int. J. Care Injured 44 (2013) 611–617

Contents lists available at SciVerse ScienceDirect

Injury

journal homepage: www.elsevier.com/locate/injury

Does increased prehospital replacement volume lead to a poor clinical course and an increased mortality? A matched-pair analysis of 1896 patients of the Trauma Registry of the German Society for Trauma Surgery who were managed by an emergency doctor at the accident site

Bjoern Hussmann [a,*], Rolf Lefering [b], Christian Waydhas [a], Alexander Touma [a], Max D. Kauther [a], Steffen Ruchholtz [c], Sven Lendemans [a]

the Trauma Registry of the German Society for Trauma Surgery

[a] Trauma Surgery Dept., University Hospital Essen, Germany
[b] Institute for Research in Operative Medicine (IFOM), Faculty of Medicine, Witten/Herdecke University GmbH (A Non-Profit, Limited-Liability Company), Cologne Merheim Medical Centre, Germany
[c] Trauma Dept., Hand and Reconstructive Surgery Unit, University Hospital Marburg, Germany

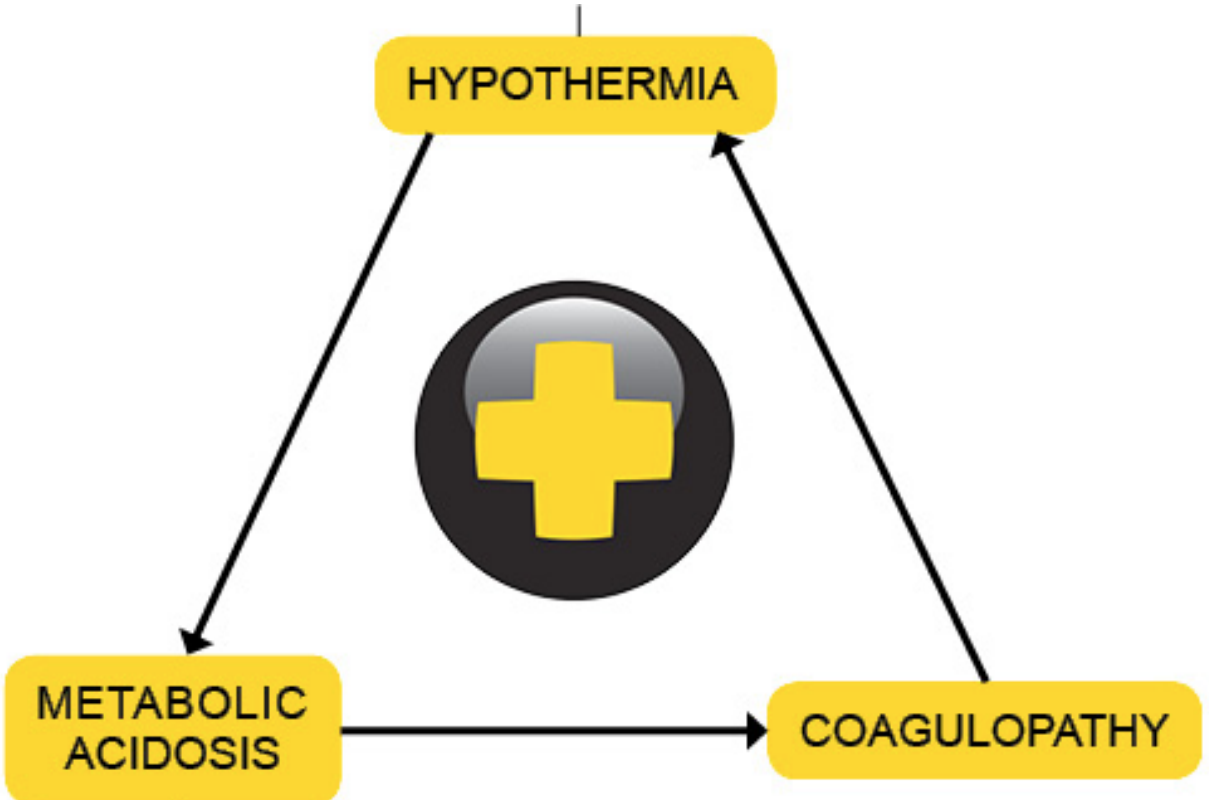
- **Pts with <1.5L did better than those >1.5L**
- **Strong study**
- **Lower death rates with less fluid 23% vs. 28% (p<.001)**

GERMAN STUDY

- **948 patients, severely injured**
  - Blunt and Penetrating
- **Retrospective matched-pair**
  - Less that 1.5L or more
- **More RBC transfusion**
- **More Coagulopathy**
- **Higher mortality 23% vs. 27%**
- **Did not have a target map**

CONCLUSION – 2 LITERS WIDE

- **High volume dangerous**
- **1 liter probably OK**



PERMISSIVE HYPOTENSION

- **Gaining popularity**
- **Not applicable in TBI !!!**
- **CPP = MAP - ICP**

PERMISSIVE HYPOTENSION

- **Animal studies support limited fluid resuscitation**
- **Lets review some relevant clinical studies**

The New England
Journal of Medicine

Volume 331 OCTOBER 27, 1994 Number 17

IMMEDIATE VERSUS DELAYED FLUID RESUSCITATION FOR HYPOTENSIVE PATIENTS WITH PENETRATING TORSO INJURIES

WILLIAM H. BICKELL, M.D., MATTHEW J. WALL, JR., M.D., PAUL E. PEPE, M.D.,
R. RUSSELL MARTIN, M.D., VICTORIA F. GINGER, M.S.N., MARY K. ALLEN, B.A.,
AND KENNETH J. MATTOX, M.D.

598 pts with SBP<90 PENTRATING TRAUMA

PROSPECTIVE, RANDOMIZED

203/289 (70%) survived without fluids

193/309 (62%) survived with fluids

Relative change 18%

Good Data!

Journal of Trauma-Injury Infection & Critical Care:
June 2002 - Volume 52 - Issue 6 - pp 1141-1146
Original Articles

Hypotensive Resuscitation during Active Hemorrhage: Impact on In-Hospital Mortality

Dutton, Richard P. MD, MBA; Mackenzie, Colin F. MD; Scalea, Thomas M. MD

- **Maryland – Included blunt trauma**
- **Prospective and randomized**
- **Target MAP of 70 vs 100**
- **Adjusted fluids accordingly**
- **No difference in mortality or morbidity**
- **However, MAP between groups similar**
- **Not a pre-hospital study**

J Trauma. 2011 Mar;70(3):652-63. doi: 10.1097/TA.0b013e31820e77ea.

Hypotensive resuscitation strategy reduces transfusion requirements and severe postoperative coagulopathy in trauma patients with hemorrhagic shock: preliminary results of a randomized controlled trial.

Morrison CA, Carrick MM, Norman MA, Scott BG, Welsh FJ, Tsai P, Liscum KR, Wall MJ Jr, Mattox KL.

Department of Surgery, Baylor College of Medicine, Houston, Texas, USA. camorris@bcm.edu

- **90 patients - penetrating**
- **Prospective Randomized Controlled Study**
- **Target MAP of 50 vs. Target MAP of 65**
- **Lower MAP**
  - Less blood products
  - Less coagulopathy
  - Fewer early post op-deaths
  - Trend to lower mortality ?? Underpowered

A good one!

Not an EMS study though

CONCLUSION FOR LOW TARGET MAP

- **Indicated in trauma close to a trauma center**
- **Unclear in Blunt Trauma**
- **No studies with TBI**
  - CBF=MAP-ICP

COLLOID

- **Colloid refers to microscopic particles that disperse easily in fluid.**
- **Can draw fluid from tissues into the blood vessels**
- **Starch, Dextran, Protein (albumin)**

Colloids versus crystalloids for fluid resuscitation in critically ill patients (Review)

Perel P, Roberts I, Ker K

COLLOID

- ❑ **Failed to show improvement**
- ❑ **Starches were associated with increased mortality**
- ❑ **Disappointing for EMS**
- ❑ **Expensive**

HYPERTONIC SALINE

- ❑ **Again osmotic draw**
- ❑ **Helpful in TBI**
- ❑ **Immune modulation**
- ❑ **Easy to give**

HTS

- **Studies have not shown improvement.**
- **A major high quality EMS study was stopped short for statistical futility**
- **Still may be a role for HTS in TBI**

PLASMA

- **May address coagulopathy of trauma**
- **Volume expander**
- **FFP vs. other types**
- **The future?**
  - Fibrinogen
  - Lyophilized Plasma

MASSIVE TRANSFUSION

- Questions about crystalloid to blood product ratio
- 1:1:1 transfusions
- Protocols for any hospital seeing trauma

SO WHERE WHAT DO WE DO?

- **Confused??**
  - So is everyone
- **Consensus panels**
  - That means that no one knows

NHS

National Institute for Clinical Excellence

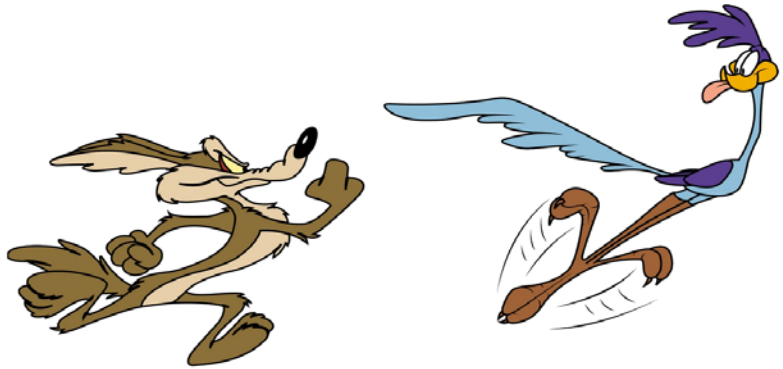
Pre-hospital initiation of fluid replacement therapy in trauma

2004

NICS RECOMMENDATIONS

- ❑ **No fluids unless no radial pulse**
- ❑ **250cc aliquots of Saline**
- ❑ **Used central pulse as indicator for penetrating torso trauma**

Comments?



DAMAGE CONTROL TRAUMA MANAGEMENT

- ❑ **Miminal fluids**
- ❑ **Permissive hypotension**
- ❑ **Brief stabilizing surgery**
- ❑ **Optimized resuscitation**
- ❑ **Return trips to OR**

SEPSIS

- Should we give him some tylenol?

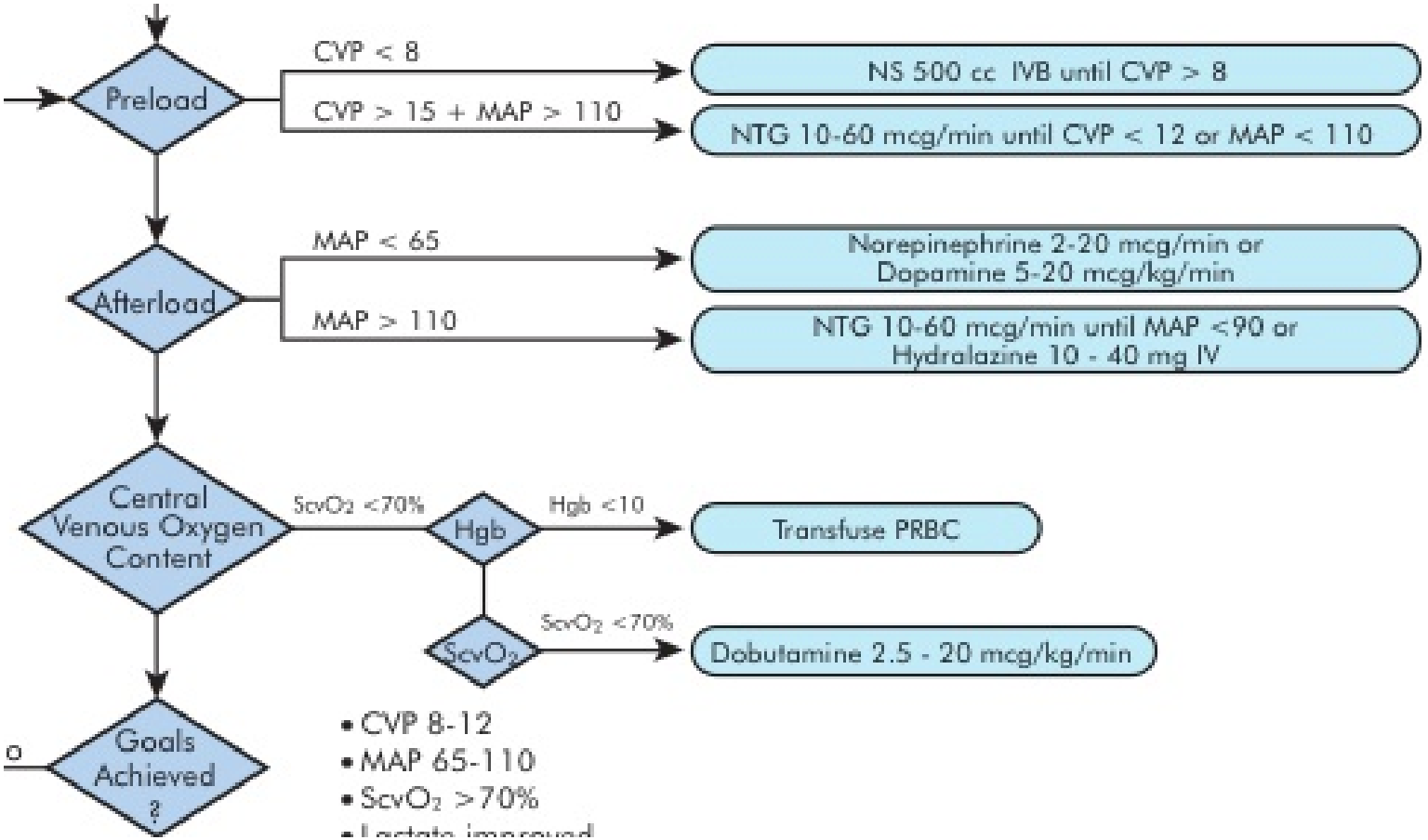
BAD ILLNESS

- **1.5 million cases of sepsis**
- **High 25% mortality**
- **As high as 60% mortality with shock**

WE CAN MAKE A DIFFERENCE

- **Goal Directed therapy**
- **Targets measurable endpoints**
  - Central Venous Pressure
  - SVO2
  - MAP

ALGORITHM


Preload
CVP < 8
NS 500 cc IVB until CVP > 8
CVP > 15 + MAP > 110
NTG 10-60 mcg/min until CVP < 12 or MAP < 110
Afterload
MAP < 65
Norepinephrine 2-20 mcg/min or
Dopamine 5-20 mcg/kg/min
MAP > 110
NTG 10-60 mcg/min until MAP <90 or
Hydralazine 10 - 40 mg IV
Central Venous Oxygen Content
ScvO2 <70%
Hgb
Hgb <10
Transfuse PRBC
ScvO2
ScvO2 <70%
Dobutamine 2.5 - 20 mcg/kg/min
Goals Achieved ?
• CVP 8-12
• MAP 65-110
• ScvO2 >70%

ER/ICU/CRITICAL CARE TRANSPORT

- **Fluid resuscitation**
  - 2L wide (if safe), then
  - 500cc boluses if MAP less than 60
  - Want MAP around 65-75
    - Higher in the elderly
  - Good perfusion helps with O_2 delivery
  - Watch for respiratory Distress
    - ARDS
    - Volume overload (Systolic dysfunction)

PHYSIOLOGY

- **Preload – fluid**
- **Afterload**
  - Pressors, Vasodilators (Nitro)
- **Oxygen Delivery**
  - SVO_2
  - Oxygen, Transfusion, Optimize cardiac output

OPTIMIZING SVO_2

- **Cardiac output**
  - Preload
  - Afterload
  - Contractility
- **Oxygen carrying capacity**
  - Saturation
  - Hemoglobin

TARGETS

- ❑ **MAP > 65**
- ❑ **CVP 12-14**
- ❑ **SVO_2 > 70**
- ❑ **HCT > 30**
- ❑ **SAT > 96 (not always high flow)**

SUPERIOR VENA CAVA O_2 SATURATION

- **Target 65-70**
- **Oxygen extraction**
- **Over => under utilization**
- **Under => tissue stress**
- **Maximize oxygen carrying capacity**

CENTRAL VENOUS PRESSURE

- **Central line in near atrium**
- **Measures pre-load**
- **Allows SVO_2 measurements**
- **Gives some idea of cardiac function**

70 YEAR OLD MAN

- **Pneumonia / ARDS / Septic shock**
- **Transport to 3º Care**
- **MAP=60, HR=60, RR=Vent, T=39.0**
- **SVO_2=85, CVP=8**
- **Therapy?**

30 YEAR OLD PERINEPHRIC ABSCESS

- **MAP=110, HR=120, RR=Vent, T=35.5**
- **CVP=14, SVO_2 = 55**
- **Prolonged cap refill**
- **Treatment options?**

PREHOSPITAL

- 45 year old with sudden belly pain yesterday, getting worse, fainted
- MAP=50, non-palpable radial pulse, HR=140, Hot to the touch, fast cap refill
- Therapy?
- Testing?

QUESTIONS COMENTS?

THANK YOU

THANK YOUR OEMS STAFF