ANESTHESIOLOGY FOR THE TRAUMA PATIENT

Christopher Patrick Henson, DO
Assistant Professor, Vanderbilt University Medical Center
Department of Anesthesiology, Division of Anesthesiology Critical Care
WHAT DOES THE TRAUMA PATIENT LOOK LIKE?

Older in age

WHAT DOES THE TRAUMA PATIENT LOOK LIKE?

More expensive to take care of

### WHAT DOES THE TRAUMA PATIENT LOOK LIKE?

<table>
<thead>
<tr>
<th>AGE</th>
<th>NUMBER</th>
<th>PERCENT</th>
<th>DEATHS</th>
<th>CASE FATALITY RATE</th>
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<tbody>
<tr>
<td>&lt;1 year</td>
<td>9,275</td>
<td>1.08</td>
<td>203</td>
<td>2.19</td>
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<td>24,734</td>
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<td>540</td>
<td>2.18</td>
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<td>5-9</td>
<td>28,094</td>
<td>3.26</td>
<td>618</td>
<td>2.20</td>
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<td>559</td>
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<td>15-19</td>
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<td>20-24</td>
<td>66,103</td>
<td>7.67</td>
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<td>12.50</td>
<td>3,847</td>
<td>3.57</td>
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<td>82,781</td>
<td>9.60</td>
<td>2,776</td>
<td>3.35</td>
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<tr>
<td>45-54</td>
<td>97,233</td>
<td>11.28</td>
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<td>55-64</td>
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<tr>
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<td>861,888</td>
<td>100</td>
<td>37,825</td>
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Over 50% of trauma patients 45 or older

https://www.facs.org/~media/files/quality20programs/trauma/ntdb/ntdb20annual20report202016.ashx
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Higher mortality rate in >45 age group

https://www.facs.org/~/media/files/quality%20programs/trauma/ntdb/ntdb%20annual%20report%202016.ashx
WHAT DOES THE TRAUMA PATIENT LOOK LIKE?

• Young, but getting older
• Still mostly blunt trauma
• More comorbidities
• More likely to survive to the ED
• More likely to make it to the OR
• More opportunity
WHAT DOES THE TRAUMA OR LOOK LIKE?

https://aneskey.com/trauma-and-burn-anesthesia/
WHAT NEEDS TO HAPPEN BEFORE SURGERY?

• Rapid history
  • “Do you have any allergies to medications?”
  • “Have you ever had problems with anesthesia?”
  • “Do you have problems with your heart or lungs?”
  • “Do you have any major medical problems?”
  • “What was the last thing you had to eat?”
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• Rapid history
  • “Do you have any allergies to medications?”
  • “Have you ever had problems with anesthesia?”
  • “Do you have problems with your heart or lungs?”
  • “Do you have any major medical problems?”

• ALL TRAUMA PATIENTS HAVE “FULL STOMACHS”
WHAT NEEDS TO HAPPEN BEFORE SURGERY?

• Rapid history

• Focused physical exam (airway+)
  • Rapid “ABCDE”
  • “Open your mouth wide”
  • Presence of cervical collar
  • Distracting injuries
  • Where are the holes (if any)?
AIRWAY ASSESSMENT

The Mallampati Score

**CLASS I**
Complete visualization of the soft palate

**CLASS II**
Complete visualization of the uvula

**CLASS III**
Visualization of only the base of the uvula

**CLASS IV**
Soft palate is not visible at all

https://www.clinicaladvisor.com/home/the-waiting-room/understanding-the-mallampati-score/
WHAT NEEDS TO HAPPEN BEFORE SURGERY?

• Rapid history

• Rapid physical exam (airway+)

• Assessment of haves/needs
  • Vital signs

  • Access
- Both deliver fluids rapidly and warm along the way
- At higher flow rates, Belmont may be better able to warm fluids/handle air
**INTRAVENOUS ACCESS CHOICES**

- In vitro flow through access devices improves as diameter increases.

- At some point, length becomes more important than diameter (why, for instance 14 gauge and 8.5 Fr RIC are similar).

- Addition of pressure bag allows for better utilization of diameter.

---

Central access is not necessary for fluid resuscitation

- Large-bore access via CVL may be necessary for severe hemodynamic instability, ongoing resuscitation, certain types of cases

- Typically not recommended to delay urgent case for central access
DO WE NEED ARTERIAL ACCESS?

- Noninvasive blood pressure (i.e. cuff) is probably going to correlate with actual blood pressure to a point.

- SBP of 80 is a reasonable cutoff above which BP cuff appears to be reliable.

- In some shock states, peripheral vasoconstriction and centralization of blood volume is so profound that radial arterial access will not give more accurate numbers.

- Consider more proximal site (axillary or femoral) if you need a more accurate measure of blood pressure.
Assessing Acid–Base Status in Circulatory Failure: Relationship Between Arterial and Peripheral Venous Blood Gas Measurements in Hypovolemic Shock

Scott E. Rudkin, MD, MBA¹, Craig L. Anderson, MPH, PhD¹, Tristan R. Grogan, MS²,³, David A. Elashoff, PhD²,³, and Richard M. Treger, MD³,⁴

Conclusions

In the presence of hypovolemic shock, unlike central and mixed venous blood, the peripheral venous blood fails to exhibit a selective respiratory acidosis and is therefore a poor reflection of acid–base status of critical tissues. Further work needs to be done to better define the relationship between ABG and both central and peripheral VBG values in various types of shock due to decreased cardiac output versus decreased systemic vascular resistance.

Probably not accurate in hypovolemic shock/trauma
CANT WE USE PERIPHERAL VBG IN SHOCK?

Assessing Acid-Base Status in Circulatory Failure: Relationship Between Arterial and Peripheral Venous Blood Gas Measurements in Hypovolemic Shock

- Arterial line in most trauma cases
- Can be post-induction depending on stability

Reflection of acid-base status of critical tissues. Further work needs to be done to better define the relationship between ABG and both central and peripheral VBG values in various types of shock due to decreased cardiac output versus decreased systemic vascular resistance.

Probably not accurate in hypovolemic shock/trauma

WHAT NEEDS TO HAPPEN BEFORE SURGERY?

- Rapid history
- Rapid physical exam (airway+)
- Assessment of haves/needs
- Preoxygenation
- Preanesthetic time-out
  - Patient/plan/allergies/consent (blood also…)
  - “Everyone ready?”
WHAT NEEDS TO HAPPEN BEFORE SURGERY?

- Rapid history
- Rapid physical exam (airway+)
- Assessment of haves/needs
- Preoxygenation
- Preanesthetic time

Diagram showing the flow of activities before surgery, including:
- Attending
- Junior resident/CRNA
- Senior resident/CRNA
- Anesthesia cart
- Anesthesia technician
- Blood refrigerator (Outside OR)
- Crash cart (Outside OR)
• What are the concerns?
WHAT ARE THE CONCERNS?

- Difficult airway
- Pulmonary aspiration
- Medication choices
- Hypotension/low cardiac output
DIFFICULT AIRWAY

• Primarily mitigated by careful exam and plan prior to induction
AIRWAY ALGORITHM (MODIFIED FOR TRAUMA)

AIRWAY ALGORITHM (MODIFIED FOR TRAUMA)

• What are the real risks and how can we reduce them or optimize patient?
Retrospective data suggesting that emergency surgery might not be strongly associated with aspiration

In defined cases of aspiration, emergency and associated problems the most common risk factor


<table>
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<tr>
<th>Rank</th>
<th>Cause</th>
<th>Frequency</th>
</tr>
</thead>
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<td>Emergency†</td>
<td>21</td>
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<tr>
<td>2</td>
<td>Inadequate anaesthesia*</td>
<td>18</td>
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<tr>
<td>3</td>
<td>Abdominal pathology§</td>
<td>17</td>
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<tr>
<td>4</td>
<td>Obesity</td>
<td>15</td>
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<tr>
<td>5</td>
<td>Opioid medication‡</td>
<td>13</td>
</tr>
<tr>
<td>6</td>
<td>Neurological deficit**</td>
<td>10</td>
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<tr>
<td>7</td>
<td>Lithotomy</td>
<td>8</td>
</tr>
<tr>
<td>8</td>
<td>Difficult intubation/airway</td>
<td>8</td>
</tr>
<tr>
<td>9</td>
<td>Reflux§</td>
<td>7</td>
</tr>
<tr>
<td>10</td>
<td>Hiatus hernia</td>
<td>6</td>
</tr>
</tbody>
</table>
Acute Intraoperative Pulmonary Aspiration

Katie S. Nason, MD, MPH

The technique for RSI includes the following:

- Preoxygenation
- Rapid administration of induction and paralytic agents that are not titrated to effect
- Cricoid pressure (originally described but not currently recommended for all patients)
- Avoidance of bag and mask ventilation
- Transoral insertion of an endotracheal tube using direct or video laryngoscopy

- “impact of RSI on prevention of aspiration…is unclear”
- “literature…insufficient to determine whether RSI reduces aspiration”
- “no data to support the routine use of cricoid pressure”

• Sham procedure not inferior to cricoid pressure in preventing aspiration during RSI
• Findings similar in post hoc analysis of emergency cases

Effect of Cricoid Pressure Compared With a Sham Procedure in the Rapid Sequence Induction of Anesthesia:
The IRIS Randomized Clinical Trial

- Patients with recent trauma definitely have delayed gastric emptying

- Use of RSI and cricoid pressure remains standard, although situation and context important

- Patient status and complicating factors may necessitate consideration of modified approach


preventing aspiration during RSI
• Findings similar in post hoc analysis of emergency cases
• Two primary classes: sedative/hypnotic and paralytics

• Choice of induction/management agents should be based upon patient stability and expectations

• Main goal of induction agent is to provide enough sedative to facilitate safe endotracheal intubation and initiation of surgery

• Major risks are hypotension from vasodilation and myocardial depression
• Many induction drug challenges can be mitigated by thoughtful and slow dosing (i.e. hypotension with propofol)

• However, induction might take 2-3 minutes during which time patient is unstable, at risk of aspiration, etc.

• Ketamine and etomidate avoid many of the problems with decreased SVR/MAP and patients typically will tolerate higher doses delivered more rapidly

• As with anything, dose is paramount, and patients in shock typically have altered responses

• Decreased circulation times coupled with centralization of blood volume result in altered timing
NEUROMUSCULAR BLOCKADE

• Equivalent response/adequate intubating conditions in 45-60 seconds after high dose rocuronium or succinylcholine

• Risks/rewards should factor into choice (sux problems, availability of rapid roc reversal with suggammadex)

• Can consider dissociated/“awake” intubations without paralytic or with lower dose sedative+topicalization depending on needs

• Given the needs in the operating room, there is probably little utility in this EXCEPT in certain types of obstructive shock (tamponade, tension, PE) where maintenance of spontaneous ventilation may be important
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• Given the needs in the operating room, there is probably little utility in this EXCEPT in certain types of obstructive shock (tamponade, tension, PE) where maintenance of spontaneous ventilation may be important

“‘Ive never seen an airway that was easier without paralytics”

- First shot=best shot

- Remember some patients depend heavily on preload and cardiac output may suffer with positive pressure ventilation
WHAT NEEDS TO HAPPEN BEFORE SURGERY?

- Prepped, draped, scrubbed
- “Everybody ready?”
- Induce -> Intubate -> + EtCO2 -> Cut
MAINTENANCE OF ANESTHESIA

- Volatile anesthetics are reliable, but vasodilate
- Midazolam and ketamine are potent, but wear off
- Scopolamine at higher doses inhibits memory formation and is vagolytic but maybe not in TBI and hard to get
MAINTENANCE OF ANESTHESIA

- Long story short: “without sedation, patients remember surgery”
- High rate of PTSD in trauma patients -> also high rate of awareness during surgery for trauma (1:100 - 1:1000)
- Should make every effort to maintain a level general anesthesia during trauma surgery, but can be difficult

• Volatile anesthetics are reliable, but vasodilate
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Long story short: “without sedation, patients remember surgery”

High rate of PTSD also high rate of awareness during surgery (1:100-1:1000)

Should make every effort to maintain a level general anesthesia during trauma surgery

Bispectral index monitoring (BIS) may allow for some titration of sedation depth, but still debatable

- Volatile anesthetics are reliable, but vasodilator
- Midazolam and ketamine are potent, but wear off
- Scopolamine at higher doses inhibits memory formation and is vagolytic but maybe not in TBI and hard to get
HYPOTENSION

• Causes of hypotension?
  • Absolute hypovolemia
  • Relative hypovolemia
  • Cardiac dysfunction
  • Vasodilation
Predictors of Hypotension After Induction of General Anesthesia

David L. Reich, MD, Sabera Hossain, MA, Marina Krol, PhD, Bernard Baez, MD, Puja Patel, Ariel Bernstein, and Carol A. Bodian, DrPH

Table 6. Independent Predictors of Hypotension 0–10 Minutes after Anesthetic Induction

<table>
<thead>
<tr>
<th>Predictor</th>
<th>OR [95% CI]</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline MAP &lt; 70 mm Hg</td>
<td>5.00 [2.78–9.02]</td>
<td>&lt;0.0001</td>
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<tr>
<td>Age ≥50 yr</td>
<td>2.25 [1.75–2.89]</td>
<td>&lt;0.0001</td>
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<tr>
<td>Propofol induction (versus thiopental or etomidate)</td>
<td>3.94 [2.42–6.43]</td>
<td>&lt;0.0001</td>
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<tr>
<td>Increasing fentanyl dosage*</td>
<td>1.32 [1.13–1.56]</td>
<td>0.0008</td>
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<td>ASA III–V (versus ASA I–II)</td>
<td>1.55 [1.22–1.99]</td>
<td>0.0004</td>
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CAUSES OF HYPOTENSION

1. HYPOVOLEMIC SHOCK
2. CARDIOGENIC SHOCK
3. DISTRIBUTIVE LOW RESISTANCE SHOCK
4. OBSTRUCTIVE SHOCK

CAUSES OF HYPOTENSION

PRELOAD

1. HYPOVOLEMIC SHOCK

2. CARDIOGENIC SHOCK

NORMAL

3. DISTRIBUTIVE
   LOW RESISTANCE SHOCK

4. OBSTRUCTIVE SHOCK
   HIGH RESISTANCE SHOCK

AFTERLOAD

CAUSES OF HYPOTENSION

1. HYPOVOLEMIC SHOCK

2. CARDIIOCGENIC SHOCK

3. DISTRIBUTIVE LOW RESISTANCE SHOCK

4. OBSTRUCTIVE HIGH RESISTANCE SHOCK

CAUSES OF HYPOTENSION

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ITS ALL VOLUME, REALLY
CAUSES OF HYPOTENSION

Resuscitation inadequate
Acidaemia
Positive pressure (PPV)
Induction agents
Disease

Credit: Chris Nickson (LITFL blog)

Does vasopressor therapy have an indication in hemorrhagic shock?


Vasopressors for hypotensive shock (Review)


Vasopressin in Hemorrhagic Shock: A Systematic Review and Meta-Analysis of Randomized Animal Trials


Use of Vasopressor Increases the Risk of Mortality in Traumatic Hemorrhagic Shock: A Nationwide Cohort Study in Japan

Does vasopressor therapy have an indication in hemorrhagic shock?


- Not entirely clear that vasopressors are a problem

- An approach involving only vasopressors (no fluids) is unlikely to be best

- An approach entirely avoiding vasopressors (high fluids) is unlikely to be best

- Clearly defining SBP/MAP goals is key

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CONSIDER
- SBP 80-90 WHILE SECURING HEMORRHAGE
- TBI: MAP>80
**Vasopressin in Hemorrhagic Shock: A Systematic Review and Meta-Analysis of Randomized Animal Trials**

Andrea Pasquale Cossu, Paolo Mura, Lorenzo Matteo De Giudici, Daniela Puddu, Laura Pasin, Maurizio Evangelista, Theodoros Xanthos, Mario Musu, and Gabriele Finco

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>Experimental Events</th>
<th>Experimental Total</th>
<th>Control Events</th>
<th>Control Total</th>
<th>Weight</th>
<th>Odds ratio M-H, fixed, 95% CI</th>
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</tr>
<tr>
<td>Voelckel et al. [1]</td>
<td>0</td>
<td>7</td>
<td>14</td>
<td>14</td>
<td>8.8%</td>
<td>0.00 [0.00, 0.13]</td>
</tr>
</tbody>
</table>

**Figure 2:** AVP or terlipressin versus all other strategies (fluid resuscitation, vasoconstrictors, and placebo).

**Big effect size (in animal studies) says: “maybe vasopressin in hemorrhagic shock?”**

Effect of Low-Dose Supplementation of Arginine Vasopressin on Need for Blood Product Transfusions in Patients With Trauma and Hemorrhagic Shock

A Randomized Clinical Trial

Conclusions and Clinical Trial

CONCLUSIONS AND IMPLICATIONS

Arginine vasopressin is a potent vasoconstrictor that is used mainly as an intracranial pressure monitor or to treat vasopressor-resistant hypotension. To date, the use of arginine vasopressin in trauma patients in hemorrhagic shock has not been extensively studied. Further research is necessary to determine whether arginine vasopressin can reduce the need for blood product transfusions in trauma patients. This randomized clinical trial provides preliminary evidence that low-dose supplementation of arginine vasopressin may decrease the need for blood product transfusions in trauma patients with hemorrhagic shock.
Essentially small volume crystalloid (cheap/plentiful) challenge and assess for response

Poor/non-responders get blood and further workup

Further poor response/hemodynamic compromise gets MTP with exploration
Optimal fluid resuscitation in trauma: type, timing, and total

Marcie Feinman\textsuperscript{a}, Bryan A. Cotton\textsuperscript{b}, and Elliott R. Haut\textsuperscript{a}

Table 2. Determinants of resuscitation and perfusion

<table>
<thead>
<tr>
<th>Basic measures of global resuscitation</th>
<th>Advanced measures of global resuscitation</th>
<th>Measures of global perfusion</th>
<th>Measures of regional perfusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart rate</td>
<td>Bedside echocardiography</td>
<td>Initial lactate level</td>
<td>Near-infrared spectroscopy</td>
</tr>
<tr>
<td>Shock index</td>
<td>Mixed venous oxygen saturation</td>
<td>Rate of lactate clearance</td>
<td>Sidestream dark field video microscopy</td>
</tr>
<tr>
<td>Blood pressure</td>
<td>Pulse pressure variation</td>
<td>Base deficit</td>
<td>Regional capnography</td>
</tr>
<tr>
<td>Urine output</td>
<td>Stroke volume variation</td>
<td>Bicarbonate</td>
<td>StO2 monitoring</td>
</tr>
<tr>
<td>Mental status</td>
<td>Pulmonary artery occlusion pressure</td>
<td>pH</td>
<td>CSF microdialysis</td>
</tr>
<tr>
<td>Capillary refill</td>
<td>Central venous pressure</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Optimal fluid resuscitation in trauma: type, timing, and total.

**Advanced measures of global resuscitation**

- Bedside echocardiography
- Mixed venous oxygen saturation
- Pulse pressure variation
- Stroke volume variation
- Pulmonary artery occlusion pressure
- Central venous pressure

**Table 2. Determinants of resuscitation response**

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<td>Heart rate</td>
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</table>

Hemodynamic parameters to guide fluid therapy

Paul E Marik\textsuperscript{1*}, Xavier Monnet\textsuperscript{2}, Jean-Louis Teboul\textsuperscript{2}

Figure 2 Heart-lung interactions. Hemodynamic effects of mechanical ventilation. The cyclic changes in left ventricular (LV) stroke volume are mainly related to the expiratory decrease in LV preload due to the inspiratory decrease in right ventricular (RV) filling. Reproduced with permission from Critical Care/Current Science Ltd [24].
Pulse pressure variation: beyond the fluid management of patients with shock

Frédéric Michard¹, Marcel R Lopes² and Jose-Otavio C Auler Jr³

Dynamic changes in arterial waveform derived variables and fluid responsiveness in mechanically ventilated patients: A systematic review of the literature*

Paul E. Marik, MD, FCCM; Rodrigo Cavallazzi, MD; Tajender Vasu, MD; Aymn Hirani, MD

<table>
<thead>
<tr>
<th>Variable</th>
<th>Correlation (r)</th>
<th>AUC</th>
</tr>
</thead>
<tbody>
<tr>
<td>PPV</td>
<td>.78 (0.74–0.82)</td>
<td>0.94 (0.93–0.95)</td>
</tr>
<tr>
<td>SPV</td>
<td>.72 (0.65–0.77)</td>
<td>0.86 (0.82–0.90)</td>
</tr>
<tr>
<td>SVV</td>
<td>.72 (0.66–0.78)</td>
<td>0.84 (0.78–0.88)</td>
</tr>
<tr>
<td>LVEDAI</td>
<td>—</td>
<td>0.64 (0.53–0.74)</td>
</tr>
<tr>
<td>GEDVI</td>
<td>—</td>
<td>0.56 (0.37–0.67)</td>
</tr>
<tr>
<td>CVP</td>
<td>0.13 (–0.01–0.28)</td>
<td>0.55 (0.48–0.62)</td>
</tr>
</tbody>
</table>

Higher AUC suggests higher specificity and sensitivity

Goal-directed resuscitation in the prehospital setting: A propensity-adjusted analysis

Joshua B. Brown, MD, Mitchell J. Cohen, MD, Joseph P. Minei, MD, Ronald V. Maier, MD, Michael A. West, MD, Timothy R. Billiar, MD, Andrew B. Peitzman, MD, Ernest E. Moore, MD, Joseph Cuschieri, MD, Jason L. Sperry, MD, MPH, and The Inflammation and the Host Response to Injury Investigators, Pittsburgh, Pennsylvania

Not entirely clear what the optimal resuscitation goals are; normotensive patients who receive more fluids may do worse

Damage control resuscitation in patients with severe traumatic hemorrhage: A practice management guideline from the Eastern Association for the Surgery of Trauma


<table>
<thead>
<tr>
<th>Principle</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoid/reverse hypothermia</td>
<td>Gentilello,1 Shafr2</td>
</tr>
<tr>
<td>Minimize blood loss with early hemorrhage control measures during transport and initial evaluation</td>
<td>Kragh,3 Schroll,4 Inaba,5 Leonard,6 Yong,7 Dubose8</td>
</tr>
<tr>
<td>Delay resuscitation/target low-normal blood pressure before definitive hemostasis</td>
<td>Bickell,9 Dutton10</td>
</tr>
<tr>
<td>Minimize crystalloid administration</td>
<td>Duchesne,11 Schreiber12</td>
</tr>
<tr>
<td>Use MT protocol to ensure sufficient blood products are available in a prespecified ratio</td>
<td>O'Keefe,13 Cotton14</td>
</tr>
<tr>
<td>Avoid delays in surgical or angiographic hemostasis</td>
<td>Meizoso,15 Schwartz,16 Tesoriero17</td>
</tr>
<tr>
<td>Transfuse blood components that optimize hemostasis</td>
<td>Borgman,18 Holcomb,19 Holcomb20</td>
</tr>
<tr>
<td>Obtain functional laboratory measures of coagulation (e.g., TEG or TEM) to guide ongoing resuscitation</td>
<td>Gonzalez,21 Tapia22</td>
</tr>
<tr>
<td>Give pharmacologic adjuncts to safely promote hemostasis</td>
<td>CRASH-2,23 Morrison,24 Hauser25</td>
</tr>
</tbody>
</table>

TEG, thromboelastography; TEM, thromboelastometry.

WHAT CAN WE DO IN THE OPERATING ROOM?

- Keep it warm
- Tolerate lower MAP
- Minimize/No crystalloid
- Balanced product resuscitation/MTP when appropriate

TABLE 1. Principles of damage control resuscitation

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<th>Authors</th>
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<td>Morrison</td>
</tr>
</tbody>
</table>

TEG, thromboelastography; TEM, thromboelastometry.
REVIEW OF PROBLEMS WITH CRYSTALLOIDS

- Dilutes RBC and clotting factors
- Worsens acidosis (notably normal saline) due to chloride load
- Promotes leakage of fluid and tissue edema
- Less “bang for the buck” in supporting circulation
Damage Control Resuscitation: The New Face of Damage Control

Juan C. Duchesne, MD, FACS, FCCP, Norman E. McSwain, Jr., MD, FACS, Bryan A. Cotton, MD, FACS, John P. Hunt, MD, MPH, FACS, Jeff Dellavolpe, MD, Kelly Lafaro, MD, MPH, Alan B. Marr, MD, FACS, Earnest A. Gonzalez, MD, FACS, Herb A. Phelan, MD, FACS, Tracy Bilski, MD, FACS, Patrick Greiffenstein, MD, James M. Barbeau, MD, JD, Kelly V. Rennie, MD, Christopher C. Baker, MD, FACS, Karim Brohi, MD, FRCS, FRCA, Donald H. Jenkins, MD, FACS, and Michael Rotondo, MD, FACS

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Surgical resuscitation has shifted in general to a restrictive fluid approach.
• Trauma patients present many challenges to anesthesia team - consider dedicated teams with structured plans

• Upon arrival to OR, rapid assessment and safe transition to incision paramount

• May have to modify delivery of anesthetic to hemodynamics (risk of awareness)
• Most all hypotension is volume-responsive in trauma - must be careful to resist overresuscitation (goal-directed)

• Vasopressors are reasonable adjunct to judicious fluid replacement but are unlikely to benefit hemorrhagic shock alone (consider vasopressin?)

• Minimize crystalloid resuscitation in hemorrhagic trauma, transition to balanced blood product administration

• Don’t forget about pain and emotional stressors postoperatively