REBOA

Barely in the Trauma Bay...already in the Battlefield

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Disclosures

• No financial disclosures
• Opinions herein are mine and do not represent those of SOST, AFSOC, or the DOD
Overview

• REBOA Background
• Indications and Limitations of REBOA
• REBOA cases from downrange
• How far forward should REBOA go?
REBOA Background
REBOA’s Debut

- LTC Carl W. Hughes
  - 3 cases
  - "temporized situation"
- 1986
  - 23 cases
  - "improved blood pressure"
- 2000s
  - Porcine models re-address
Procedure

• Determine appropriate occlusion Zone
  • Measure catheter insertion length
• Common Femoral Artery access
  • Cut Down vs US-guided
• 7Fr Sheath Placement
• Advancement of Catheter
• Inflation of Balloon
  • Radiographic confirmation
• Removal of Sheath/Catheter
  • Post-removal Fluoroscopy
Data in Medical Centers

• 2015 US: REBOA vs Thoracotomy at two trauma centers
  • Fewer early deaths, improved survival

• 2015 Japan: REBOA complications
  • 12.5% limb amputations

• 2016 Japan: REBOA vs without REBOA
  • Mortality higher with REBOA

• 2016 US: REBOA vs Thoracotomy via registry (8 centers)
  • No statistically significant difference in mortality

• 2017 Japan: Traumatic vs non-traumatic REBOA
  • Higher mortality in traumatic REBOA
Indications and Limitations of REBOA
Indications

- Blunt/Penetrating Trauma
  - Abdomen/Pelvis
- Non-compressible hemorrhage
- Hypotensive
- Surgical Access*
Limitations/Complications

- CFA Access
  - Rate Limiting step
  - Dissection, pseudoaneurysms, hematoma, thrombi
- Zone 2 occlusion
- Aortic Injury/Rupture
- Prolonged Occlusion
  - Spinal Cord Ischemia
  - Organ ischemia
Downrange REBOA
REBOA Procedure Downrange

• **Proactive** vs Reactive
• Early use of REBOA
• Determining candidates
  • Blood Product Use
  • Limited resources
• Limited Radiology
• Monitoring/Transfers
• Ultrasound’s Role
• Compass Centurion pressure transducer
APPENDIX A: TRAUMATIC ARREST ALGORITHM FOR REBOA

- Blunt trauma with no major chest bleeding seen on CXR, ultrasound, or bilateral chest tubes
- Penetrating trauma to abdomen/pelvis

Palpable carotid pulse?

Yes

ATLS Protocols:
- Intubation
- Volume infusion
- Rapid assessment for hemorrhage

No

Any organized EKG rhythm or cardiac contraction on ultrasound?

Yes

Isolated or devastating head injury?

No

Blunt Trauma

Penetrating Trauma

No

CPR <15 minutes

Yes

Blunt trauma?

Penetrating trauma?

A/P/J

Thoracotomy vs Zone 1 REBOA

NO REBOA
- Penetrating Neck → Operating Room
- Penetrating Chest → Thoracotomy
- Penetrating Extremity → Tourniquet, Resuscitate

Consider Thoracotomy vs REBOA if reversible cause suspected. Otherwise declare patient dead.

Clinical response?

Yes

If SBP < 90, see REBOA for Profound Shock Algorithm

No

Dead

APPENDIX B: ALGORITHM FOR THE USE OF REBOA FOR PROFOUND SHOCK

SBP<90 with Transient or No Response to initial ATLS Resuscitation

- Blunt Trauma
  - Severe Chest Injury?**
    - Yes: No REBOA
    - No: Major chest bleeding seen with CXR, ultrasound, or bilateral chest tubes
      - Suspected cardiac or aortic injury

- Abdominal FAST Positive?
  - Yes: Consider Zone I REBOA
    - Emergent Laparotomy
  - No: Pelvic Fx?
    - Yes: Consider Zone III REBOA
    - No: Penetrating
      - Neck: REBOA not indicated
        - Operating room
      - Chest: REBOA not indicated
        - Consider thoracotomy
      - A/P/J: Consider Zone I REBOA
      - Extremity: Tourniquet, Resuscitate
SOST Practice

• Hypotensive (<80 SBP)
• Abdominal or pelvic injuries
• E-FAST to rule out chest trauma
  • Alt: Bilateral chest tubes
• **Immediate** IV/IO access, femoral a-line access
  • Rate limiting step
• 2u whole blood, TXA, antibiotics

• Low threshold to upsize to 7fr sheath
• + E-FAST → Zone 1 (external landmarks)
• Pelvic fx or junctional bleed → Zone 3
REBOA placed during MASCAL by EM doc

- Situation: 12pt MASCAL
- Patient: 25yo transabdominal GSW (20 min post-injury)
  - 98/59, 127, 84%, 18, GCS 14
  - Wounds L Flank, RLQ w evisceration
  - FAST +
- Whole Blood Transfusion initiated
- A-line placed by US
- BP 60s, HR 140s
  - Upsized to 7fr, zone 1 REBOA
- OR Results: Large volume hemoperitoneum
  - Multiple root of mesentery injuries, 10x small bowel injuries, R colon injury
- Balloon time: 34 min
- Blood Products: 7U WB
- Vitals on Transfer: 127/62, 109
- “Having an competent ER doc is invaluable”
SOST Experience

- **20 REBOAs** - all male combatants
- All explosive wounds or gunshot wounds

**Placed primarily by EM:** 6
- Placed primarily by Surgeon: 14

<table>
<thead>
<tr>
<th>Data Point</th>
<th>Mean</th>
<th>Range</th>
</tr>
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<tbody>
<tr>
<td>Time from Injury</td>
<td>44min</td>
<td>15-90min</td>
</tr>
<tr>
<td>Initial GCS</td>
<td>10</td>
<td>7-15</td>
</tr>
<tr>
<td>Initial SBP</td>
<td>70mmHg</td>
<td>50-90mmHg</td>
</tr>
<tr>
<td>Initial HR</td>
<td>129</td>
<td>110-153</td>
</tr>
<tr>
<td>Rise in BP with occlusion</td>
<td>57mmHg</td>
<td>30-142mmHg</td>
</tr>
<tr>
<td>Occlusion time</td>
<td>21min</td>
<td>7-34min</td>
</tr>
<tr>
<td>Blood Products used</td>
<td>10U</td>
<td>2-21U</td>
</tr>
</tbody>
</table>
SOST Experience

Zone 1 n=17
• Mean depth 47cm (range 44-55)
• Mean volume 14ml (range 6-27)

Zone 3 n=3
• Mean depth 26cm (range 23-30)
• Mean volume 8m

• No catheter related complications*
• 1 balloon failure
Unique Advantage to the Military

- Rapid normalization of vitals
- Rapid hemorrhage control
- Less blood product usage (88 walking blood drives over 18 mo)
- Single surgeon – rapidly dry operative field
- MASCAL (75x over 18 mo)
  - EM docs place REBOA during MASCALs

- REBOA preserves precious resources, saves time, saves lives in the combat setting
How far Forward should REBOA go?
ACS/ACEP Joint Statement on REBOA

• Acute care surgeon access
• Mitigate complication risk
  • Balloon occlusion time
  • Leaving sheath in place
• Transferring with REBOA
  • NOT recommended

• Military
  • Attend formal course prior to deployment
  • EM physicians must work in conjunction with surgeon
Finding the “Sweet Spot” for REBOA

• Pre-hospital REBOA
  • British EMS system
  • Battlefield?
• Austere surgical teams
  • Training/Competency
  • Blood available
• Does not extend Golden Hour
  • Communicate this with GFC!
• Future
  • Intermittent/Partial Flow?
  • REBOA in place, deflated?
Conclusion
REBOA Take-Aways

- Proactive tool vs reactive efforts
- Understand complications and mitigate risks
- Work in conjunction with a surgeon
- Less Blood Product use
- Frees up resources
- Life-saving tool downrange; limited data on long-term outcomes
- Only as forward as surgical capability
Questions?
References


• Brenner M, et al. Joint statement from the American College of Surgeons Committee on Trauma (ACS COT) and the American College of Emergency Physicians (ACEP) regarding the clinical use of Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA). Journal of Trauma and Acute Care.

• Barnard EB, et al. Resuscitative endovascular balloon occlusion of the aorta (REBOA): a population based gap analysis of trauma patients in England and Wales


• https://hqmeded.com/resuscitative-endovascular-balloon-occlusion-aorta-reboa/


