

# JOINT TRAUMA SYSTEM



## RESUSCITATIVE ENDOVASCULAR BALLOON OCCLUSION OF THE AORTA (REBOA) FOR HEMORRHAGIC SHOCK

### CLINICAL PRACTICE GUIDELINE (CPG) TRAINING

*Joint Trauma System Trauma Care Educational Program*



# DISCLOSURE/DISCLAIMER



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# AGENDA



- ◆ Purpose
- ◆ Summary
- ◆ Background
- ◆ Indications and Techniques
- ◆ Resuscitative Aortic Occlusion (RAO) Algorithm
- ◆ REBOA for Shock Algorithm
- ◆ ER REBOA
- ◆ Pitfalls
- ◆ Performance Improvement (PI) Monitoring
- ◆ References
- ◆ Appendices
- ◆ Contributors

# PURPOSE



- ◆ These slides are based on the JTS REBOA for Hemorrhagic Shock CPG which reviews the range of accepted management approaches to profound shock and post-traumatic cardiac arrest and establishes indications for considering REBOA as a hemorrhage control adjunct.
- ◆ Date of CPG publication: 31 Mar 2020
- ◆ JTS CPGs are evidence-based guidelines developed by subject matter experts in the military and civilian communities. CPGs are compiled from DoD Trauma Registry data, health data abstracted from patient records and after action reports.
- ◆ Information contained in this presentation is only a guideline and not a substitute for clinical judgment.

# SUMMARY



- ◆ Patients exsanguinating from the abdominal, pelvic, or junctional lower extremity may be candidates for REBOA.
- ◆ REBOA can be done before the patient is in extremis in patients with high-risk injuries and unstable physiologic parameters.

# BACKGROUND



- ◆ Hemorrhage is the leading cause of preventable death on the battlefield.
  - ◆ Non-compressible torso hemorrhage (NCTH) is particularly lethal because it is occult and not amenable to control by direct pressure.
  - ◆ NCTH arises from trauma to torso vessels, organs, or bony pelvis.
- ◆ Resuscitative Aortic Occlusion (RAO) affords distal hemorrhage control while increasing afterload and central aortic pressure.
  - ◆ Used in treatment of NCTH in patients with profound shock.
  - ◆ Provides time until direct hemostasis can be obtained.
  - ◆ Options for RAO are:
    - ◇ Emergency Resuscitative Thoracotomy (ERT)
    - ◇ REBOA



# INDICATIONS & TECHNIQUES

- ◆ Initial management priorities for patients with traumatic arrest or impending arrest include early control of hemorrhage and hemostatic resuscitation.
- ◆ Multiple factors impact steps providers will take. These include:
  - ◆ Mechanism and pattern of injury
  - ◆ Presence of a pulse
  - ◆ Duration of cardiac arrest
  - ◆ Presence of cardiac activity
  - ◆ Resources available
  - ◆ Number of concurrent casualties
- ◆ Localize bleeding as best as possible with appropriate imaging or procedures.



# INDICATIONS & TECHNIQUES

REBOA may be a suitable option for the patient with traumatic arrest or impending arrest.

- ◆ Ideal for exsanguination from abdominal, pelvic, or junctional lower extremity bleeding.
- ◆ Evaluate for significant chest injury prior to use.

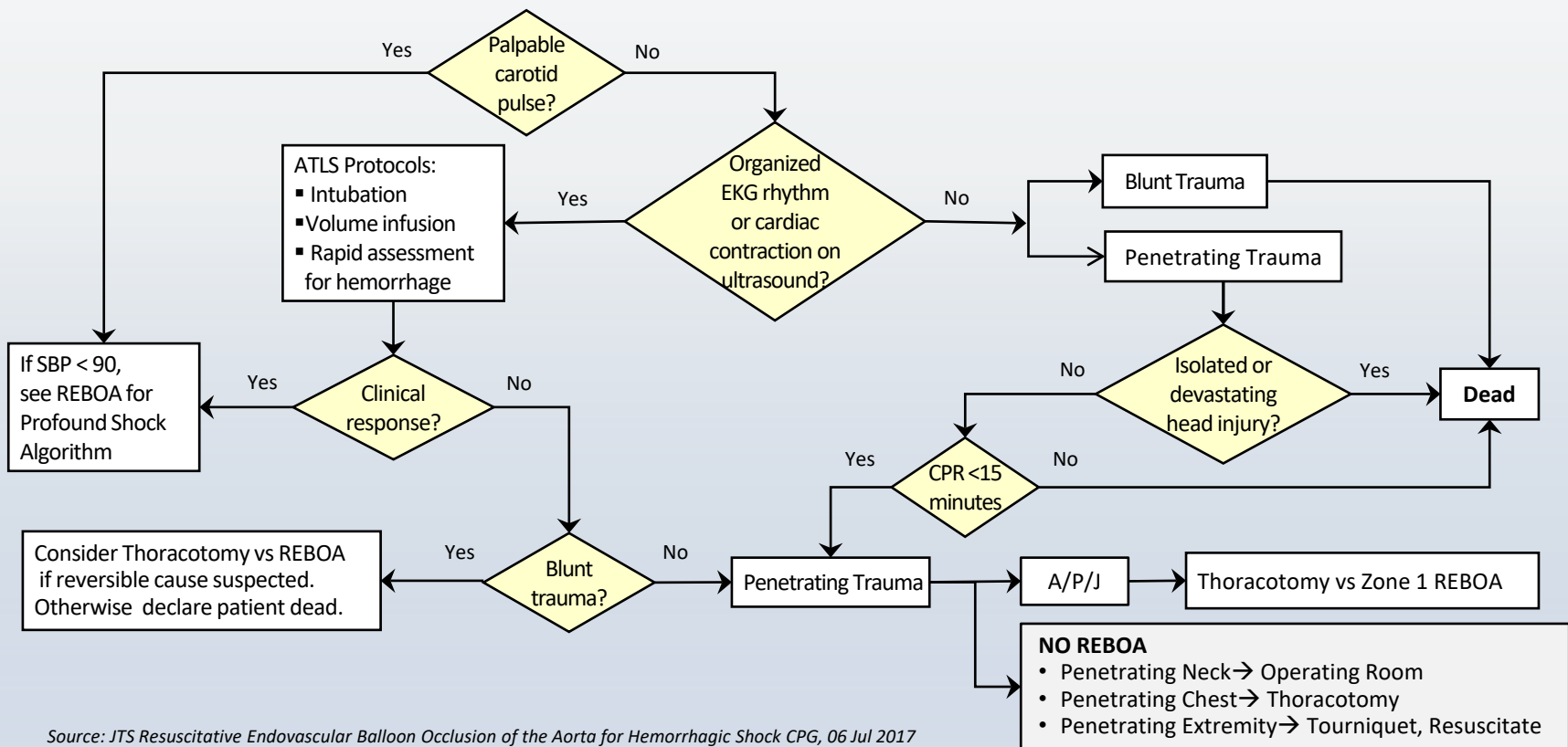






# RAO DECISION ALGORITHM

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



Source: JTS Resuscitative Endovascular Balloon Occlusion of the Aorta for Hemorrhagic Shock CPG, 06 Jul 2017



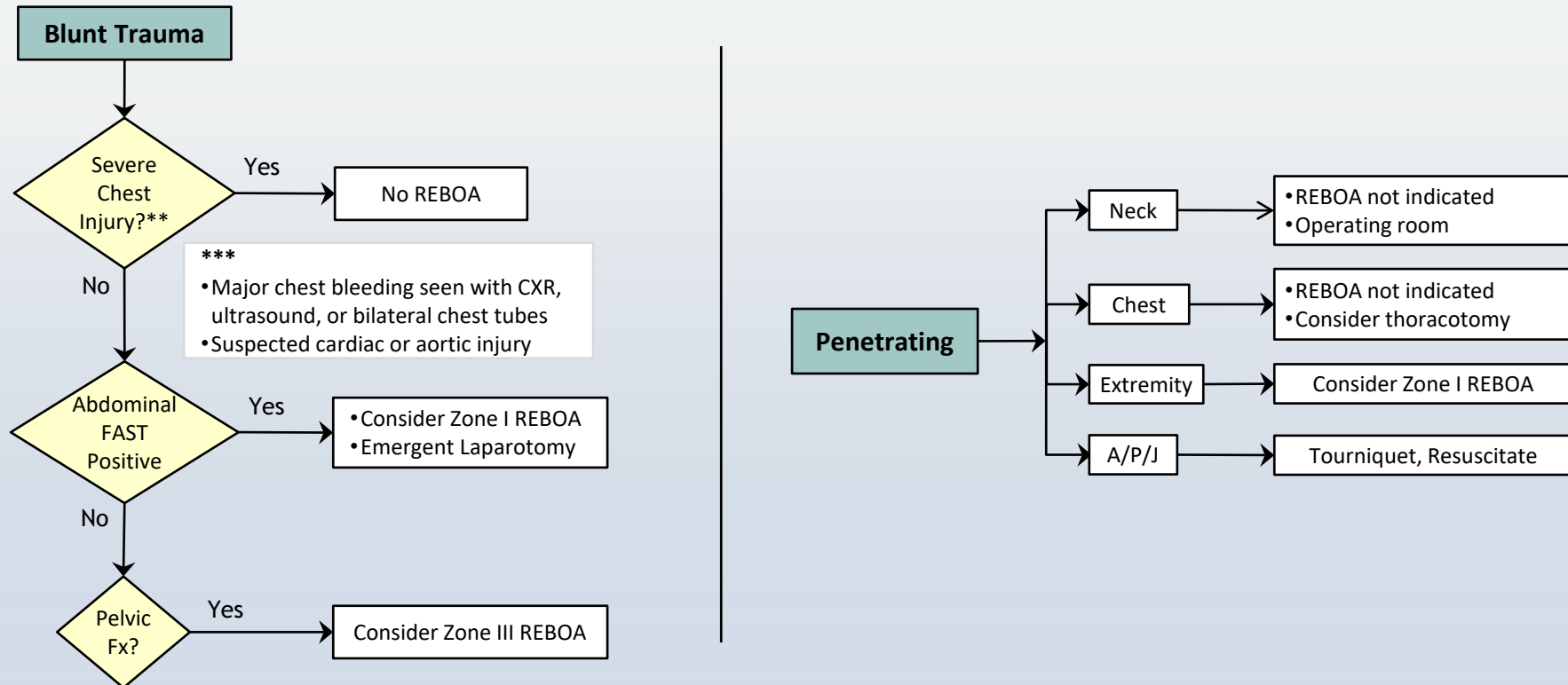
# INDICATIONS & TECHNIQUES

- ◆ Neither REBOA or ERT have been shown to be superior to the other but current recommendations are:
  - ◆ REBOA is best for patients with site of hemorrhage below the diaphragm.
  - ◆ ERT is best for patients with significant thoracic or cardiac injury.
- ◆ Best to perform REBOA prior to cardiac arrest
  - ◆ Pre-emptive placement of an arterial line in the common femoral artery can facilitate eventual REBOA.
  - ◆ If SBP < 90 with only transient or no response, REBOA can be considered.
- ◆ REBOA balloon/catheter commonly encountered is ER-REBOA (but other types/brands exist).



# ALGORITHM: REBOA FOR SHOCK

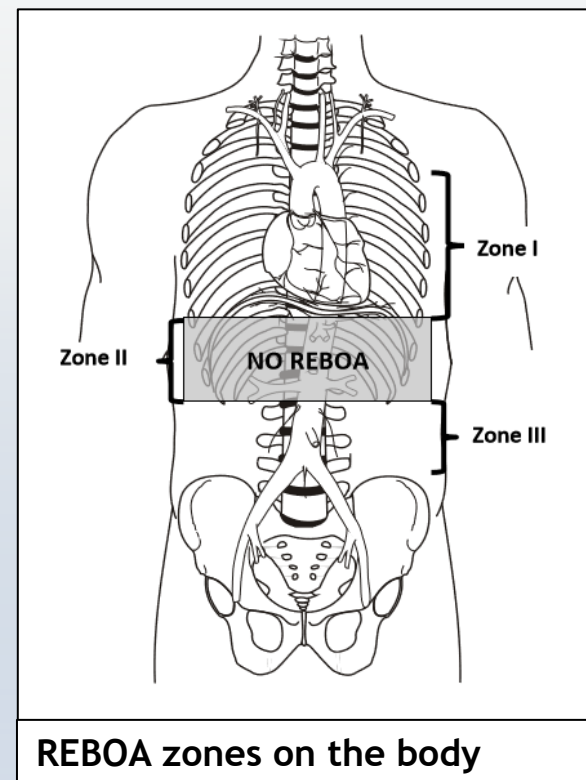
## SBP < 90 with Transient or No Response to initial ATLS Resuscitation



Source: JTS Resuscitative Endovascular Balloon Occlusion of the Aorta for Hemorrhagic Shock CPG, 06 Jul 2017

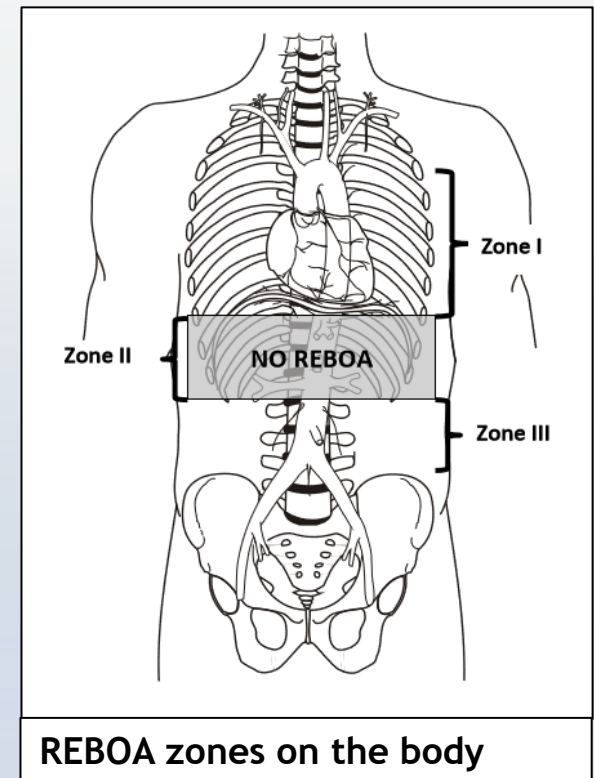
## REBOA Requires 6 General Steps using ER-REBOA

1. Arterial access and positioning of sheath
  - ◆ Obtained at common femoral Artery either open or percutaneously
  - ◆ Must have a 7 fr sheath for REBOA
2. Selection and positioning of the balloon
  - ◆ Zone I: Thoracic Aorta: 46 cm or Measured from sternal notch to femoral access catheter
  - ◆ Zone III: Pelvic or junctional femoral hemorrhage: 27 cm or measured from umbilicus to the femoral access catheter
3. Inflation of the balloon
  - ◆ Guided by fluoroscopy, hemodynamic response, and/or loss of the contralateral pulse



## REBOA Requires 6 General Steps using ER-REBOA

4. Operative/procedural control of bleeding
  - ◆ Zone I REBOA inflation time ideally less than 30 minutes with maximum of 60 minutes.
  - ◆ Zone III inflation time may be longer than Zone I.
5. Deflation of the balloon
  - ◆ Discussion prior to deflation with care team is critical.
  - ◆ Deflate slowly and anticipate a significant hemodynamic changes.
  - ◆ Intermittent balloon inflation/deflation may be necessary with ongoing resuscitation to reduce reperfusion effects.
6. Sheath Removal
  - ◆ Ideally flush with 100 mL of heparinized saline.
  - ◆ May require surgical repair.
  - ◆ Do not remove while coagulopathic.



# PITFALLS



## REBOA placement pitfalls to avoid

- ◆ Making decision to perform REBOA too late, mortality high when patient pulseless.
- ◆ Unfamiliarity with femoral artery anatomy.
- ◆ Inserting the REBOA below the femoral artery bifurcation.
- ◆ Unrecognized proximal femoral or iliac artery transection preventing endovascular access on side of injury - access side with stronger pulse, do not hesitate to switch sides, or perform thoracotomy.
- ◆ Failure to address chest pathology - always evaluate the chest and convert to thoracotomy to address massive hemothorax.
- ◆ Consider accessing the opposite groin or convert to thoracotomy if the catheter/guidewire does not pass freely.

# PITFALLS



## REBOA placement pitfalls to avoid *(continued)*:

- ◆ Over inflating the balloon - typical inflation amounts for ER-REBOA are 8 mL for Zone I and 3 mL for Zone III.
- ◆ Failure to work with heightened urgency with return of improved vital signs and subsequently leaving the balloon inflated too long (60 minutes considered a maximum).
- ◆ Failure to adequately securing REBOA with resulting migration of the balloon.
- ◆ Deflating the balloon before adequate resuscitation.
- ◆ Removal of the arterial sheath while the patient is still coagulopathic.
- ◆ Injury to the arterial access point.
- ◆ Committing resources to a futile resuscitation.

# PI MONITORING



## ◆ Population of Interest

- ◆ Patients with AIS chest, abdomen, pelvis, and/or lower limb  $\geq 3$  with SBP  $>0$  and  $<90$  or CPR in progress on arrival to first MTF AND not isolated head injury (AIS head/face/neck = 5 or 6).
- ◆ Patients who received REBOA.

## ◆ Intent (Expected Outcomes)

- ◆ REBOA is not performed in patients with no signs of life or CPR  $>15$  minutes or isolated severe TBI, penetrating neck injury, or penetrating extremity injury.
- ◆ If performed, REBOA was performed for the indication of hemorrhagic shock associated with abdominal, pelvic, or junctional lower extremity bleeding, or other indication is clearly documented.
- ◆ If REBOA performed, the patient was assessed for thoracic hemorrhage (EFAST or CXR results documented, or bilateral chest tubes placed).
- ◆ Blood pressure pre and post REBOA and balloon times (inflation and deflation) are documented in REBOA procedure note.
- ◆ Lower extremity pulses are documented after balloon deflation.



# PI MONITORING



- ◇ Performance/Adherence Metrics - number and percentage of patients who:
  - ◆ had REBOA performed for hemorrhagic shock associated with abdominal, pelvic, or junctional lower extremity bleeding.
  - ◆ had REBOA performed who were assessed for thoracic hemorrhage (EFAST or CXR results documented, or bilateral chest tubes placed).
  - ◆ had REBOA performed with complete REBOA procedure note to include documented blood pressure pre and post REBOA and documented balloon times (inflation and deflation).
  - ◆ had REBOA performed with lower extremity pulses documented after balloon deflation.
  - ◆ had REBOA performed with surgical hemorrhage control procedure or documentation that procedure not needed.
  - ◆ underwent ERT or REBOA in the population of interest.
  - ◆ did not undergo ERT or REBOA in the population of interest.
  - ◆ underwent ERT or REBOA who survived 24 hrs, 7 days, 30 days (assume alive if discharged alive prior to each time point).
  - ◆ did not undergo ERT or REBOA in the population of interest who were declared KIA/DOA or who survived 24 hrs, 7 days, 30 days (assume alive if discharged alive prior to each time point).
- ◇ Data Source
  - ◆ Patient Record
  - ◆ Department of Defense Trauma Registry

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# SLIDE TITLE



- ◆ **Appendix A:** Traumatic Arrest Algorithm for REBOA
- ◆ **Appendix B:** Algorithm for the Use of REBOA for Profound Shock
- ◆ **Appendix C:** Aortic Zones
- ◆ **Appendix D:** Equipment and Supplies for REBOA
- ◆ **Appendix E:** REBOA Steps Using the 7 French ER-REBOA
- ◆ **Appendix F:** ER-REBOA Procedure Checklist
- ◆ **Appendix G:** ER-REBOA Quick Reference Guide
- ◆ **Appendix H:** Aortic Occlusion Procedure Notes



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