

Primary Author: Jacob Bruno-Friedman, MD  
Co-Authors: Tracy Zito, MD  
Editors: Michael L. Cheatham MD, Chadwick Smith MD  
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**SUMMARY**

Resuscitative thoracotomy is a potentially life-saving intervention that involves surgically opening the left side of the thoracic cavity to rapidly identify and treat traumatic injuries that have led to cardiac arrest such as cardiac tamponade, tension hemothorax, or tension pneumothorax, or to provide hemorrhage control. It is imperative to have clear and concise guidelines on when to perform a resuscitative thoracotomy in the setting of trauma.

**RECOMMENDATIONS**

- **Level 1**
  - **None**
- **Level 2**
  - **None**
- **Level 3**
  - **Resuscitative thoracotomy should be considered for patients with thoracoabdominal penetrating injuries (with or without signs of life) who present with traumatic cardiac arrest and prehospital CPR time of <15 minutes.**
  - **Resuscitative thoracotomy should be considered for patients with blunt trauma (not isolated cranial injury) with signs of life on initial EMS evaluation who present with traumatic cardiac arrest and prehospital CPR time of <10 minutes.**
  - **Resuscitative thoracotomy should be considered as an adjunct to life-saving measures in patients with penetrating neck or extremity injury who present with traumatic cardiac arrest and prehospital CPR time of <5 minutes.**

**INTRODUCTION**

Reducing morbidity and mortality of the trauma patient is the overarching aim of the trauma surgeon. A large proportion of trauma patients arrive with hemodynamic instability and a smaller proportion in traumatic cardiac arrest. Timely decision making and intervention is paramount to improving outcomes. The following guideline is an evidence-based approach to the unstable trauma patient regarding when to perform resuscitative thoracotomy.

Resuscitative thoracotomy is a potentially life-saving intervention that should be considered in trauma patients with ongoing cardiac arrest in the setting of penetrating chest, abdominal, extremity, or neck trauma, as well as blunt trauma. This is an especially aggressive intervention with a high mortality rate and considerable morbidity; therefore, there should be careful consideration on a case-by-case basis of the patient's injury pattern, current condition, and presence or absence of signs of life before conducting this intervention.

**LEVEL OF RECOMMENDATION DEFINITIONS**

- **Level 1:** Usually based on Class I data (prospective, randomized clinical trials) or strong Class II evidence (prospective, non-randomized trials) if randomized testing is inappropriate. Conversely, low quality or contradictory Class I data may be insufficient to support a Level I recommendation.
- **Level 2:** Reasonably justifiable based on available scientific evidence and strongly supported by expert opinion. Usually supported by Class II data or a preponderance of Class III evidence (retrospective data).
- **Level 3:** Supported by available data, but scientific evidence is lacking. Generally supported by Class III data or expert opinion.

DISCLAIMER: These guidelines were prepared by the Department of Surgical Education, Orlando Regional Medical Center. They are intended as a general statement regarding appropriate patient care practices based on the medical literature and clinical expertise at the time of development. They should not be considered protocol or policy nor are intended to replace clinical judgment or dictate care of individual patients.

## **DEFINITIONS**

- Signs of life: Pupillary response, spontaneous ventilation, presence of carotid pulse, measurable or palpable blood pressure, extremity movement, cardiac electrical activity (1-3,10).
- Prehospital CPR time: Time from initiation of chest compressions after identification of pulselessness either during transport to a trauma center or upon arrival of emergency medical service members to the scene with a patient in extremis and signs of life (2,3,7,8,10).

## **INDICATIONS FOR RESUSCITATIVE THORACOTOMY**

1. For patients arriving pulseless after penetrating thoracic trauma and ongoing prehospital CPR for less than 15 minutes, resuscitative thoracotomy should be considered (2,3,5,7-10).
2. For patients arriving pulseless after penetrating abdominal trauma and ongoing prehospital CPR for less than 15 minutes, resuscitative thoracotomy should be considered as an adjunct to abdominal exploration and hemorrhage control (2,3,5,7-10).
3. For patients arriving pulseless after penetrating neck or extremity trauma and ongoing prehospital CPR for less than 5 minutes, resuscitative thoracotomy should be considered as an adjunct to life-saving measures (4).
4. For patients arriving pulseless after blunt trauma and ongoing prehospital CPR for less than 10 minutes with signs of life, resuscitative thoracotomy should be considered (1-3,5,7-10).

## **CONTRAINDICATIONS TO RESUSCITATIVE THORACOTOMY**

1. Patients arriving pulseless after isolated cranial injury regardless of prehospital CPR timing should not undergo resuscitative thoracotomy (2,3,5).
2. Patients arriving pulseless after penetrating thoracic or abdominal trauma and ongoing prehospital CPR for greater than 15 minutes without signs of life should not undergo resuscitative thoracotomy (1-3,5,7-10).
3. Patients arriving pulseless after blunt trauma and ongoing prehospital CPR for greater than 10 minutes without signs of life should not undergo resuscitative thoracotomy (1-3,5,7-10).
4. Patients arriving pulseless after penetrating neck or extremity trauma with ongoing prehospital CPR for greater than 5 minutes should not undergo resuscitative thoracotomy (4).

## **METHOD OF RESUSCITATIVE THORACOTOMY (Left Anterolateral Thoracotomy)**

Starting at the 4<sup>th</sup> or 5<sup>th</sup> intercostal space, or inframammary fold in females, a broad swipe of a #10 blade is made from the sternum towards the bed angling up toward the axilla along the path of the rib space. This movement is intended to reach the thoracic cavity; no more than three swipes should be needed followed by using scissors, if necessary, to open the pleura and avoid direct damage to the intrathoracic organs. A rib spreader retractor (i.e., Finochietto) is placed with the crank mechanism toward the axilla to not obstruct the field. The pericardium should be grasped with toothed forceps and incised with scissors from the apex to the aortic root anterior to the phrenic nerve and the heart delivered relieving any tamponade and identifying of cardiac injury. Cardiac massage should begin promptly unless cardiac injury is identified which can be repaired with nonabsorbable 3-0 suture in a running fashion, direct finger occlusion, or by placement of a Foley balloon into the wound with tubing clamped. Cardiac massage is conducted with wrists apposed and a hinged, clapping motion from palm to finger from apex to the base of the heart. During this effort, intracardiac epinephrine can be used as well as defibrillation with internal paddles. Following these measures, the patient's vitals are reassessed. Declaration of death should follow identification of asystole. Return of spontaneous circulation should be followed by descending aortic cross clamping to assist the patient in generating a systolic pressure greater than 70mmHg. The left inferior pulmonary ligament is divided bluntly with finger fracture or with the use of scissors taking care to avoid the inferior pulmonary vein. The left lung is retracted anterior and cephalad, and the parietal pleura posterior to the aorta is divided allowing for cross clamp entry. Avoidance of clamping the esophagus can be achieved through the assistance of a nasogastric or orogastric tube the presence of which can be palpated. Further treatment is indicated based upon the patient's injury pattern (3,6).

## **CLAMSHELL THORACOTOMY**

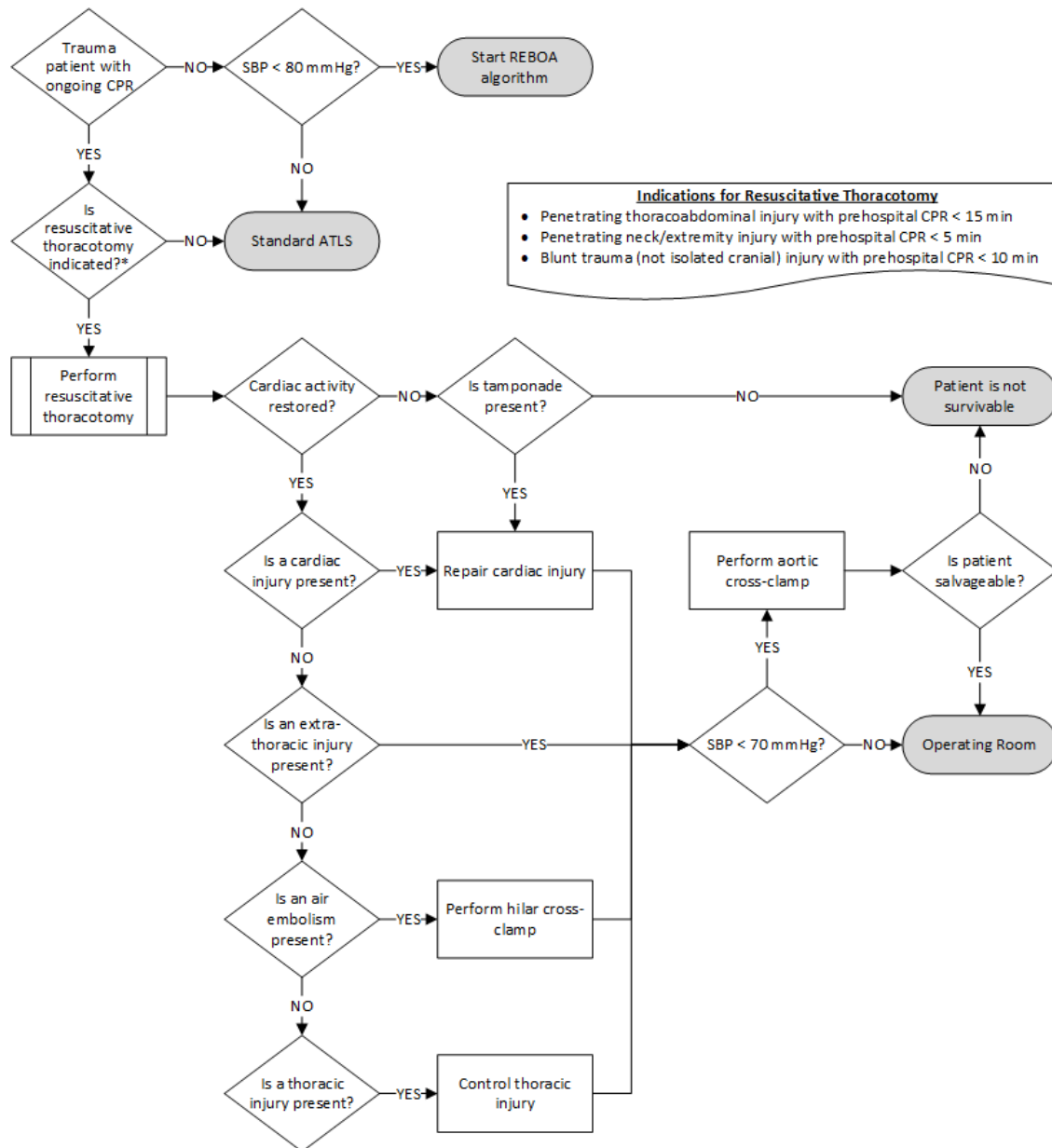
With return of cardiac function and suspicion of injury in the right chest, or if there is a need for more exposure of the chest structures, extension to a clamshell thoracotomy should be performed. The same incision is made on the right side in the same manner for a right anterolateral thoracotomy, connecting the skin and subcutaneous incisions over the sternum. The sternum is transected using a Gigli saw, a Lebschke knife or in small, frail individuals or children, a curved Mayo scissors. The identification and ligation of both the left and right inferior mammary artery and the replacement of the rib spreader at the sternum to maximize chest wall separation is paramount (3,6). Any

treatment that is needed for life sustainment is performed and if the patient has cardiac activity and a sustaining systolic blood pressure, the patient is transferred immediately to the operating room for needed interventions.

**RESUSCITATIVE THORACOTOMY MANEUVERS**

1. Opening of the pericardium
2. Open cardiac massage and/or internal defibrillation (if indicated)
3. Intracardiac epinephrine injection (if indicated)
4. Stopping cardiac or pulmonary hemorrhage
5. Hilar cross-clamp (if indicated)
6. Descending aortic cross-clamping

**ORLANDO HEALTH RESUSCITATIVE THORACOTOMY ALGORITHM**



For the REBOA algorithm, please refer to the REBOA guideline

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