Emergency Department Thoracotomy

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Objectives

- Background of RT
- Indications for RT
- Contraindications for RT
- Survival Benefits
- Techniques and Salvage Maneuvers
- Critical Thinking (Case studies)
- Conclusions, Recommendations, and Opinions
Conflict of Interest

I have nothing to disclose
Background:

- A life-saving procedure in a select group of patients
- Up to 60% survival in a very select group
- Literature shows significant controversy
- Indications and outcomes vary widely
- Every center’s experience varies widely as well
• Contributing factors to decision to perform
  • Surgeon experience/comfort level
  • Training and practice location
  • OR availability
  • Consultants (CT/vasc)

• Some training programs teach to never perform for any type of blunt trauma

• Surgeons that may have trained in a non-urban center with low volume trauma may not be comfortable performing.
History

1900 Rehn - First report of successful management of traumatic cardiac injury

1902 Hill – First successful “prehospital” thoracotomy and cardiac repair was performed on a kitchen table in Montgomery, Alabama
Video:
https://www.youtube.com/watch?v=EYpLtDbGSEA
Rationale for RT

- Overall survival between 4-33%
- Performed on patients in extremis
- Mechanism of injury plays a major role in survivability
- “Christmas Gift” analogy
- Of survivors, >90% functional neurologic recovery
- “Practice” when you can, to be able to fix those that can be salvaged
Rationale Cont’d

Traumatic arrest with penetrating trauma:

- USELESS
  - Closed chest CPR
  - ACLS Protocol/meds
- NEED
  - Blood/hemorrhage control
  - Evacuation of cardiac tamponade
  - Open cardiac CPR
Who Gets Cut???

• Remains a source of controversy

Accepted Indications

vs.

Relative Indications

vs.

Contraindications
What are accepted Signs of life?

- Any Cardiac activity (including PEA)
- Brainstem Reflexes – pupil, cough, gag, corneal, breathing
- Extremity Movement
- Blood Pressure
- Carotid pulse
- GCS >3
Why get cut?

- Primary aims of RT
  - Release of Cardiac Tamponade
- Control of Hemorrhage
- Allow access for internal Cardiac Massage
- Allow Cross-clamping of the descending thoracic aorta
Primary Causes of Traumatic Arrest

• Hypoxia
  • Tracheal intubation is mandatory
• Hemorrhage
  • Control of hemorrhage first then fluids/blood
• Tension Pneumothorax
  • Needle decompression, or chest tubes
• Cardiac Tamponade
  • Drainage**
Accepted Indications

• Penetrating thoracic injury
  • Traumatic arrest with previously witnessed cardiac activity (pre-hospital or in-hospital)
  • Unresponsive Hypotension
• Blunt thoracic injury
  • Unresponsive hypotension
  • Rapid exsanguination from chest tube (** >1500 ml)
Relative Indications

- Penetrating thoracic injury
  - Traumatic arrest without previously witnessed cardiac activity
- Penetrating non-thoracic injury (Neck, Abdomen, Ext)
  - Traumatic arrest with previously witnessed cardiac activity (pre-hospital or in-hospital)
- Blunt thoracic injuries
  - Traumatic arrest with previously witnessed cardiac activity (pre-hospital or in-hospital)
Contraindications

• Blunt Injuries
  • Blunt thoracic injuries with no witnessed cardiac activity
  • Multiple blunt trauma
  • Severe head injury
Indications: *** Western

- Blunt trauma patients with <10 min of Pre-hospital CPR
- Penetrating Torso patients with <15 min of Pre-hospital CPR
- Penetrating trauma to the Neck or Extremities with <5 min of Pre-Hospital CPR
- Patients in profound refractory shock

“Western Trauma Association Critical Decisions in Trauma: Resuscitative Thoracotomy”
J. Of Trauma and Acute Care Surgery, 2012
EAST Recommendations

In patients who present pulseless to the Emergency Department with signs of life after penetrating thoracic injury, we strongly recommend resuscitative Emergency Department thoracotomy. **Strong Recommendation**

In patients who present pulseless to the Emergency Department without signs of life after penetrating thoracic injury, we conditionally recommend resuscitative Emergency Department thoracotomy. **Conditional Recommendation**

In patients who present pulseless to the Emergency Department with signs of life after penetrating extra-thoracic injury, we conditionally recommend resuscitative Emergency Department thoracotomy. **Conditional Recommendation**

In patients who present pulseless to the Emergency Department without signs of life after penetrating extra-thoracic injury, we conditionally recommend resuscitative Emergency Department thoracotomy. **Conditional Recommendation**

In patients who present pulseless to the Emergency Department with signs of life after blunt injury, we conditionally recommend resuscitative Emergency Department thoracotomy. **Conditional Recommendation**

In patients who present pulseless to the Emergency Department without signs of life after blunt injury, we conditionally recommend against resuscitative Emergency Department thoracotomy. **Conditional Recommendation**
Asensio, JA et al. J of Trauma 1998

• 105 Penetrating Cardiac Injuries (68 gsw, 37 ksw)
  • 35 survived (11 gsw, 24 ksw)
  • 71 people underwent ER RT (10 of those survived)
• Predictors of Survivability
  • Presence of sinus rhythm when pericardium was entered
  • Site of Injury/presence of tamponade did NOT predict survivability
  • GSW’s, exsanguinations, early restoration of BP – Most predictive of mortality
Rhee, P M, et all, J of ACS 2000

• Retrospective review of 24 studies over 25 years
• N= 4,620 cases for Blunt and Penetrating trauma
• Overall survival rate ➔ 7.4% with 92% normal neurological outcome

• Highest influence on Outcome
  • MOI
  • Location of Main Injury (LOMI)
  • Signs of Life (SOL)
Rhee Cont’d

- **MOI**
  - Penetrating 8.8% survival
    - 16.8% KSW and 4.3% for GSW
  - Blunt 1.4%

- **LOMI**
  - 10.7% Thoracic injuries
  - 4.5% Abdominal
  - 0.7% Multiple

- **SOL**
  - 11.5% if present on arrival
  - 2.6% if absent
  - 8.9% if present during transport

Best chance of survival is if you are stabbed in the thorax and have signs of Life on arrival to the Emergency Department.

• Retrospective Review, One Urban trauma center for EDT’s over 23 years.
• N = 950
• 4.4% overall survival rate (3.9% neurologically intact)
  • Blunt Trauma 2.5% survival had field vital signs present

• 26% of penetrating survivors had NO vitals in the field

• Stab wounds to the chest and GSW’s to the abdomen were most likely to survive.
Seamon, M et al.  J of Trauma 2008

- Retrospective review of 235 EDT (2000-2006)
- 50 were done for Abdominal Bleeding
- Endpoint - Neurologically intact hospital survival
  - 98% - GSW to abdomen
  - 16% (n=8) Survival without neurological deficit
  - 78% had ED SOL

- Conclusion - Pre-laparotomy EDT provides survival benefit for patients dying of massive intra-abdominal bleeding.
Role Of FAST?

- All 9 survivors of 77 thoracotomies had cardiac motion on FAST
- 45/54 patients with cardiac activity died
- There were no survivors in patients undergoing ERT that did not have cardiac motion on FAST

- Sensitivity = 100% predict potential Survival
- Negative Predictive Value = 100%
Now that we know who to do it to.....
How do we do it??
Video:
https://www.youtube.com/watch?v=A57ZB_J4FuY
Materials Needed:

• The right Patient!!!
• #10 Blade
• Curved Heavy Mayo scissors
• Rib Spreader
• Gigli Saw or “Trauma Shears”
• Metzenbaum Scissors
• Long DeBakey Forceps
• DeBakey Aortic Clamp
• Large and Small Satinsky vascular clamp
• Long and Short needle Drivers
• Suction and Light!!!
Materials Continued

• 2/0 and 3/0 Nylon/Prolene sutures
• 2/0 and O ties
• Laparotomy pads
• Teflon pledgets
• Large skin Stapler???
• Foley Catheter???
Approach

• Supine anterolateral thoracotomy. Left Side mainly
  • Don’t Lacerate the lung
  • 1-2 minutes
• This approach may be extended across the sternum (Clamshell) Gigli saw or trauma shears
  • Don’t get a “spontaneous rupture of the left ventricle”
• Relief of Tamponade
  • Opened longitudinally to avoid damaging the phrenic nerve.
  • Small incision with scissors then tear longitudinally with fingers.
Cardiac Wounds

• Initially controlled with direct pressure
• Large wounds may temporarily controlled with a foley
• Satinsky clamps can be used on wounds to the atria
• Using a large skin stapler can temporarily control a significant ventricular defect
• Cardiac wounds can be repaired directly with 2/0 or 3/0 nylon or prolene in the beating heart
  • Teflon are not necessary in the left ventricle
  • Use mattress sutures in the region of the coronary vessels
• Atrial wounds are repaired in a running technique
Pulmonary and Hilar

- Direct finger pressure initially / Satinsky clamp across the hilum
- Hemorrhage from the lung parenchyma can be controlled with a clamp
  - Tractotomy using a vascular stapler for lung parenchymal injury
- Total Pneumonectomy for uncontrollable bleeding using a TA stapler
- Suture repair of Hilum is very difficult in ER and should be accomplished in OR
Great Vessel Injuries

- Small Aortic injuries can be repaired directly
- Larger injuries may require digital occlusion and repair in OR with Cardiac Bypass
Internal Cardiac Massage

• In traumatic arrest—Should be initiated ASAP following relief of tamponade and control of cardiac hemorrhage

• Two Handed technique gives better cardiac output and low risk of cardiac perforation.
Aortic Cross-Clamping

• Redistributes blood flow to the coronary vessels, lungs, and brain and reduces exsanguination from injuries in the lower torso
• Clamp time should be <30 min
• Ideally at the level of the diaphragm
• Lung is retracted anteriorly and mediastinal pleura is “incised”
• Separate the aorta from the esophagus with blunt dissection
  • Only enough to place a clamp across the aorta
  • NGT/OGT helps identify the esophagus
Anterolateral Thoracotomy incision
Anterolateral Thoracotomy
Pericardial Incision
Clamshell Incision
Clamshell with Median Sternotomy
Foley Catheter Used to Temporize
Algorithm’s

To Complex to use in the Emergency Department in the acute setting
24 y/o male, gsw to right chest. No exit. No vitals on the scene. CPR ongoing for five minutes. Airway has been established???
ER Thoracotomy through the Left chest
65 y/o female. MVC. Unresponsive on the scene. GCS - 3 entire time. Pupils are fixed and dilated. Not breathing over vent. Becomes asystolic in the ER???
Dealer’s Choice about ACLS resuscitation.

NO Role for Thoracotomy
18 y/o Male. KSW to left of sternum. GCS of 15 in the ER. 100 → 135 HR. BP drops from 125 → 70 systolic. Enlarged heart on CXR???
Intubate
Therapeutic pericardiocentesis?
Get to the OR if you can
If continues to deteriorate
→ ER thoracotomy for release of tamponade +/- repair → OR
44 y/o male. MCC. Helmeted. GCS 12 on scene. Intubated. Distended abdomen. Tachycardic and hypotensive enroute. Loses vitals on helicopter pad???
This is a tough one!
Books say yes. No one will fault you if you don’t.
If you do: Crossclamp aorta to regain HR and BP→OR for Laparotomy
In the OR exploring abdomen for blunt trauma. Liver and Spleen injuries. Pt. Loses vitals. What do you do??
Begin ACLS protocol. I would perform left thoracotomy if I couldn’t crossclamp aorta below diaphragm. Open cardiac massage until return of vitals. Then tend to my injuries in the abdomen.
Key Points and Conclusions

• Controversial Role
• Blunt trauma
  • low survival rate (But, there are survivors)
  • Very select patients
• Preparation is key!
  • ER rooms stocked
  • Trays available and people know where they are.
(Remember list of needed items)
Key Points and Conclusions

• As the Trauma Surgeon
  • PRACTICE!!
  • Review scenarios before they are in front of you
  • Algorithms are nice, but impractical in the moment
  • Know your hospital and resources
    • OR availability
    • Consultant availability
  • This procedure is performed on dead and dying patients. You will not make them worse!!
Key Points and Conclusions

• If you are going to have a penetrating chest injury
  • Try to get stabbed in the heart
  • Maintain your vitals until you reach the ER
  • Then you can crash!!! You have the highest chance of survival with that injury