Emergent Resuscitative Thoracotomy, Open Cardiac Massage, and Aortic Occlusion

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Indications

- Penetrating chest trauma with recent or immanent loss of vital signs
- Consider in blunt trauma with pericardial tamponade or exsanguination where aortic occlusion may provide proximal control

Contraindications

Absolute

- Prolonged cessation of vital signs
- Injury profile obviously incompatible with life
- Absence of surgical services to whom care can be transferred

Relative

- None

Materials and Medications (Fig. 27.1)

- Betadine (povidone-iodine) for rapid skin preparation
- #10 scalpel
- Mayo or long Metzenbaum scissors
- Finochietto retractor (rib spreader)
- Long DeBakey or other tissue forceps (2)
- Satinsky vascular clamp and/or straight vascular clamp
- Long needle holders (2)
- Lebsche knife or sternal osteotome with hammer
- Lap sponges or gauze pads

Procedure

Resuscitative Thoracotomy and Open Cardiac Massage

1. Rapidly prepare the entire anterior and bilateral chest with Betadine.
2. Using a scalpel, incise the skin and subcutaneous tissue from just right of the sternum to the anterior margin of the left latissimus dorsi, following the curvature of the inframammary crease or the fourth or fifth intercostal space (Fig. 27.2).
   - This incision is often made too low on the patient's chest. It should extend across the sternum, not at the level of the xiphoid. Upward retraction of the breast may help provide access to the fourth or fifth intercostal space, where the incision should be located.
3. Bluntly enter the right pleural space through the fourth or fifth intercostal space.
4. Using scissors, cut the intercostal muscles, dividing between the fourth and the fifth ribs from the sternum to the posterior axillary line.
5. If better exposure to the heart is desired, some practitioners advocate extending the incision across the sternum using a Lebsche knife, sternal osteotome, or bone-cutting forceps at this time (Fig. 27.3).
   - If the thoracotomy incision extends to or through the sternum, tie off the internal mammary arteries before closing the chest should the patient be successfully resuscitated, because these will have been divided with the incision.

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L. Ganti (ed.), *Atlas of Emergency Medicine Procedures*, https://doi.org/10.1007/978-3-030-85047-0_27

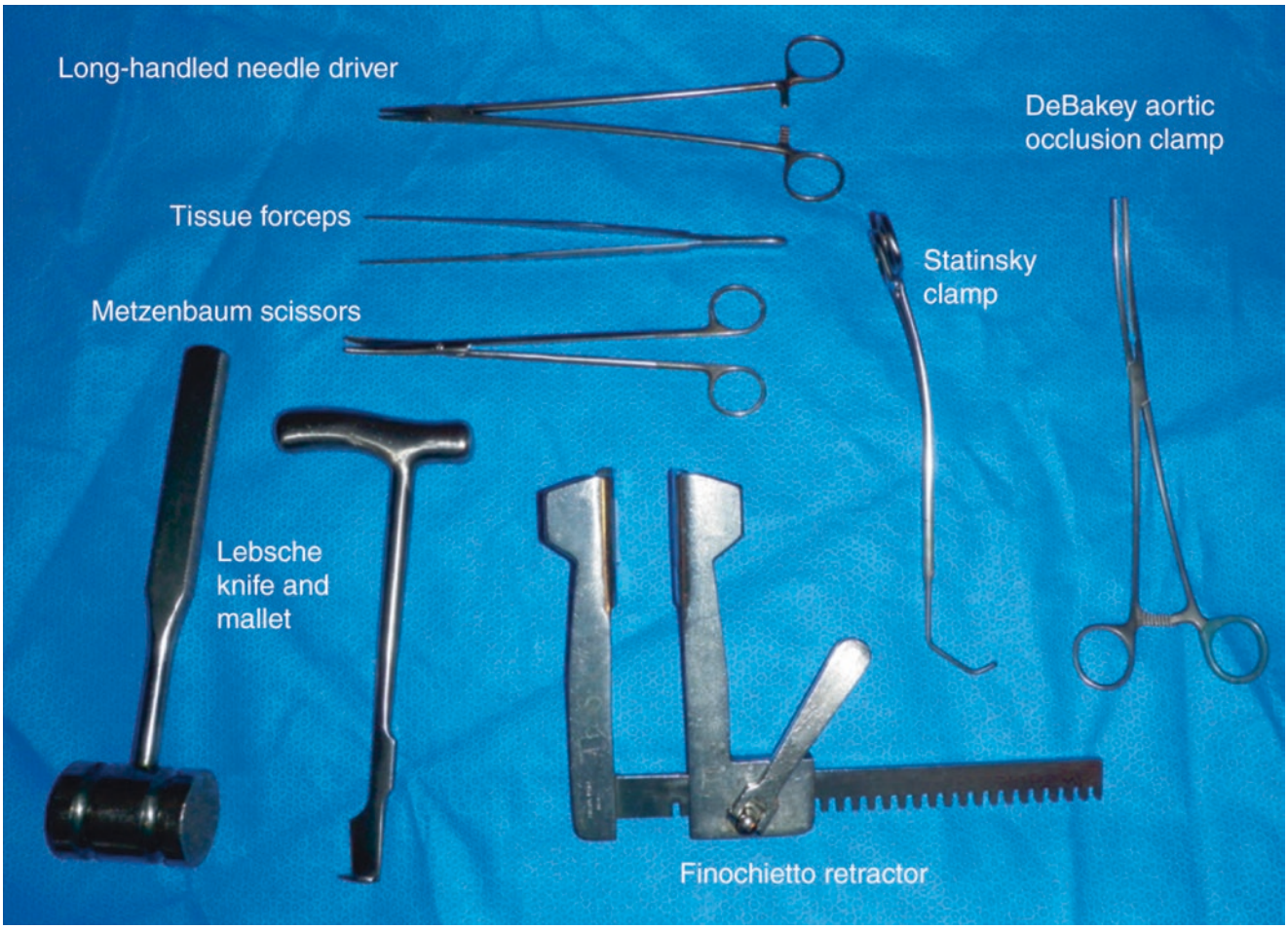

Fig. 27.1 Basic components of an emergency thoracotomy tray: Lebsche knife and mallet for crossing sternum (bone-cutting forceps or sternal osteotome would also suffice), Finochietto retractor, atraumatic vascular clamps (a Satinsky clamp and a DeBakey aortic occlusion clamp), long-handled needle driver, tissue forceps, and Metzenbaum scissors. *Not illustrated* scalpel with #10 or #20 blade, Mayo scissors

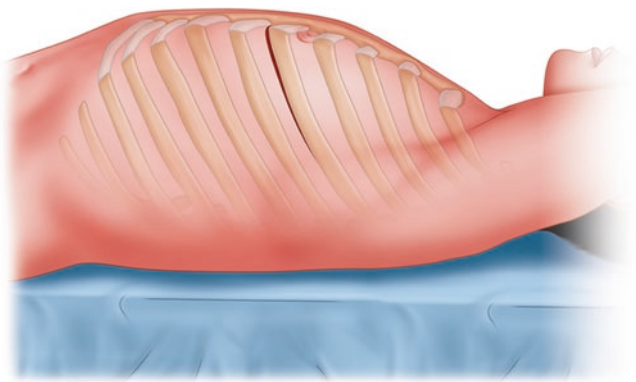

Fig. 27.2 Raise the left arm above the head. Make an incision along the left fourth intercostal space, just below the nipple in a male or at the inframammary crease in a female

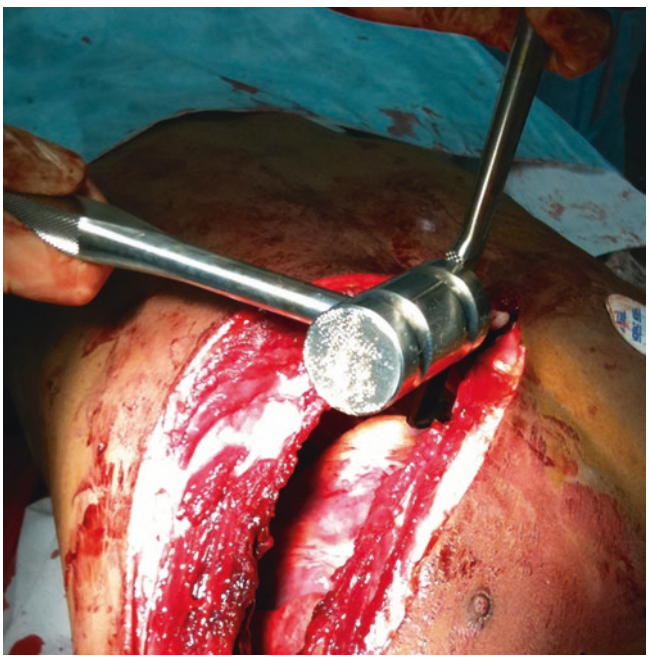

Fig. 27.3 Use a Lebsche knife to extend the incision across the sternum to improve exposure to the heart

6. Insert a Finochietto retractor, and retract the ribs in order to gain access to the left chest and expose the pericardium (Figs. 27.4 and 27.5).

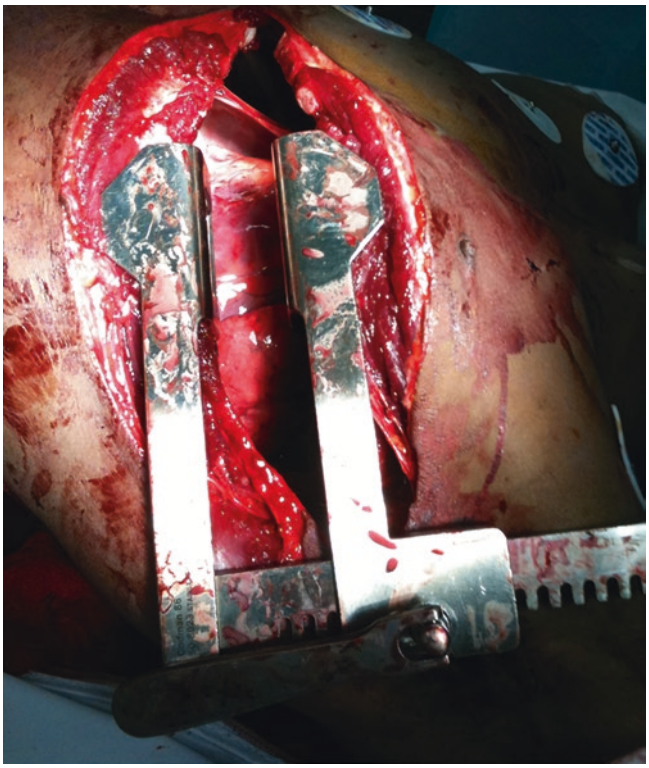

Fig. 27.4 Finochietto retractor placed through the fourth intercostal anterolateral incision. Note the rack and pinion bar placed posterolaterally, where it will not impede access to the midline

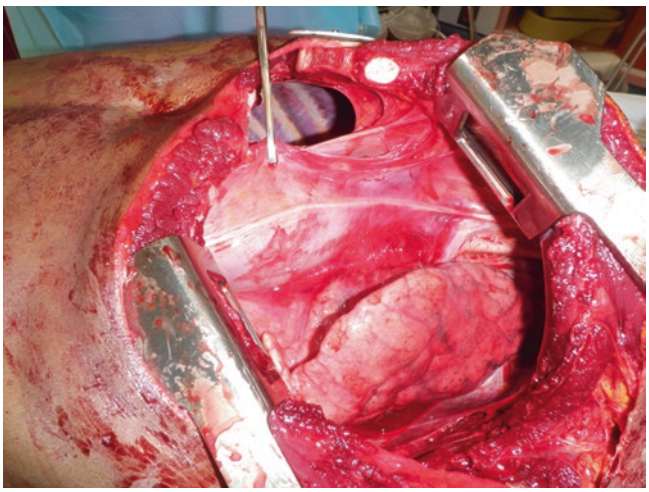

Fig. 27.5 Finochietto retractor extended, exposing the left pleural space and the pericardium. In this case, the sternum has been divided as above, and the resultant window into the right pleural space is seen anterior to the pericardium. The lung is deflated in this postmortem picture but would be far more an obstacle in the actively ventilated patient. The clamp seen in the upper portion of the picture is reapproximating the pericardium, which has previously been divided, for the sake of illustration

- Insert a Finochietto retractor with the rack and pinion bar down and lateral, as in Fig. 27.4, so as not to interfere with extension of the thoracotomy across the sternum into a clamshell maneuver if needed.

7. If massive left pleural hemorrhage is encountered, investigate and control the source at this time.
8. Using tissue forceps, raise a portion of the pericardium anterior to the phrenic nerve, and enter the pericardium using scissors (Fig. 27.6).
9. Widely open the pericardium with scissors, cutting in a cranial-caudal direction anterior to the phrenic nerve, and deliver the heart (Fig. 27.7).
10. If hemopericardium is encountered, investigate for and initiate appropriate repair of identified cardiac injuries.
11. Initiate open cardiac massage by cupping the heart between the flattened palmar aspect of the fingers of both hands and rhythmically compressing the heart from apex to base, relaxing completely between compressions to allow filling (Fig. 27.8).

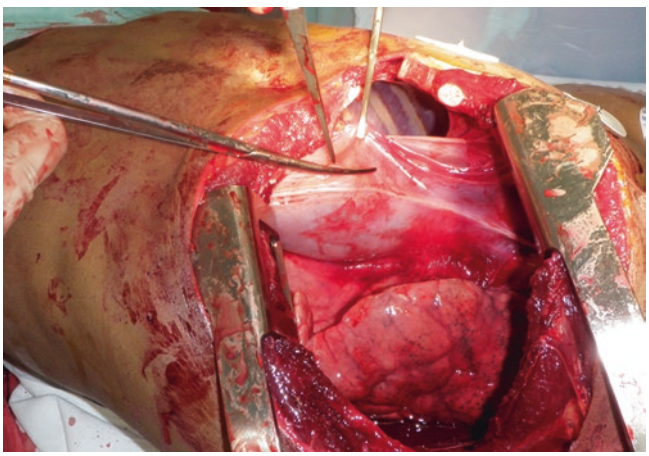

Fig. 27.6 The pericardium is lifted with tissue forceps and opened with a nick using scissors. The phrenic nerve is easily visualized running cranial-caudal just below the scissors in this picture

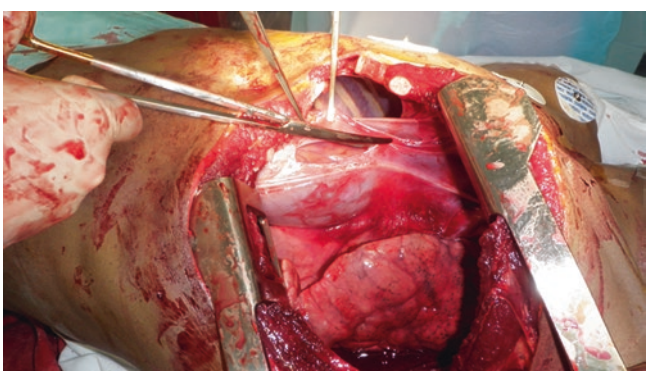

Fig. 27.7 Open the pericardium widely in the cephalad-caudad plane anterior to the phrenic nerve, taking care not to damage the phrenic nerve

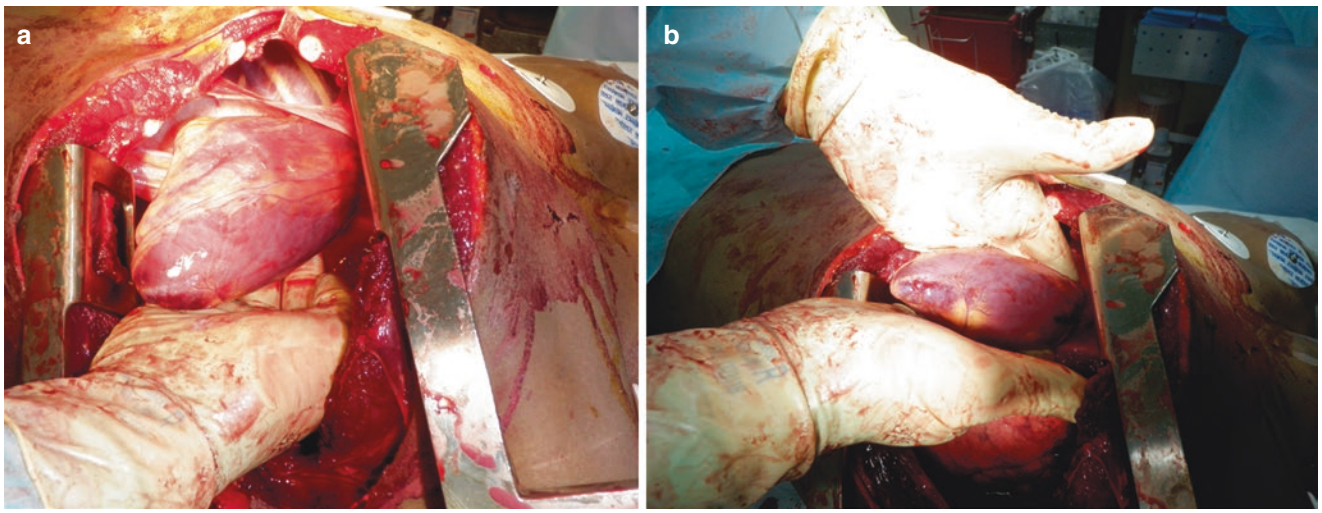

Fig. 27.8 (**a**) Deliver the heart from the pericardium, and rapidly assess for cardiac injury requiring damage control repair; (**b**) initiate open cardiac massage

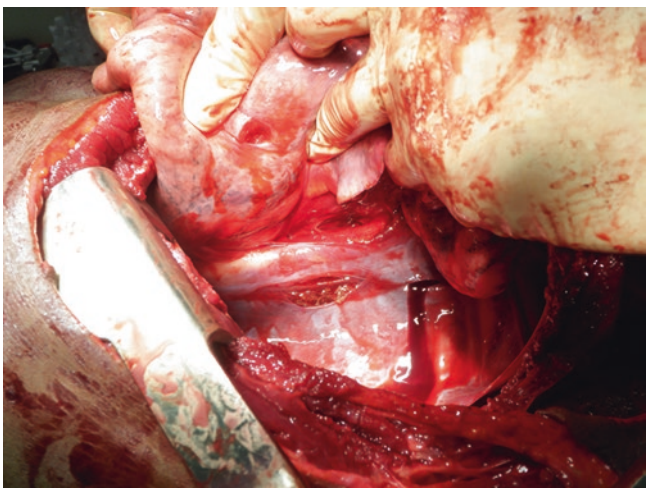

Fig. 27.9 The heart and lung are retracted superomedially, allowing visualization of the left posterior mediastinal pleura; the aorta lies just anterior to the vertebral bodies and has been previously isolated through the pleural interruptions seen here. The heart and lung are assertively retracted here for the benefit of illustration of the posterior mediastinum. Such retraction would completely occlude venous return

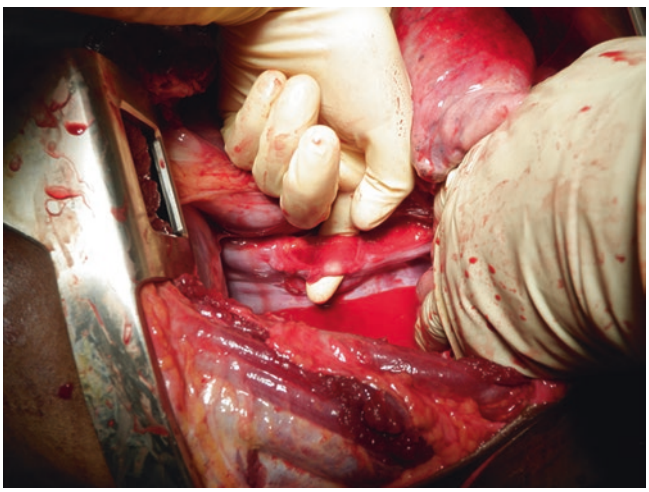

Fig. 27.10 After bluntly dissecting the mediastinal pleura, the aorta is looped using a finger of the nondominant hand

Aortic Occlusion

1. Expose the posterior aspect of the left mediastinum by having an assistant retract the left lung superomedially, dividing the inferior pulmonary ligament if necessary (Fig. 27.9).
2. Bluntly dissect the pleura separating the pleural and mediastinal space just anterior to the vertebral bodies, exposing the aorta (Fig. 27.9).
3. Completely encircle the aorta with the finger of the nondominant hand (Fig. 27.10).
   - Differentiating the aorta from the esophagus when the patient is in a state of profound shock is very difficult. Having an assistant pass, an orogastric tube may help distinguish the two. The aorta should be the most posterior structure, lying immediately on the anterior aspect of the vertebral bodies.
4. With the aorta completely encircled, place a vascular clamp across the aorta, and verify by sight and feel that the complete vessel is occluded within the clamp (Fig. 27.11).

Complications

- Injury to care providers, by means of scalpel, needlestick, or sharp foreign body, is the principal concern.
- Postemergency department thoracotomy infections are rare, even given the less than optimal sterile conditions.
- Damage to the lung parenchyma during the initial incision is common and often leads to air leak in survivors.

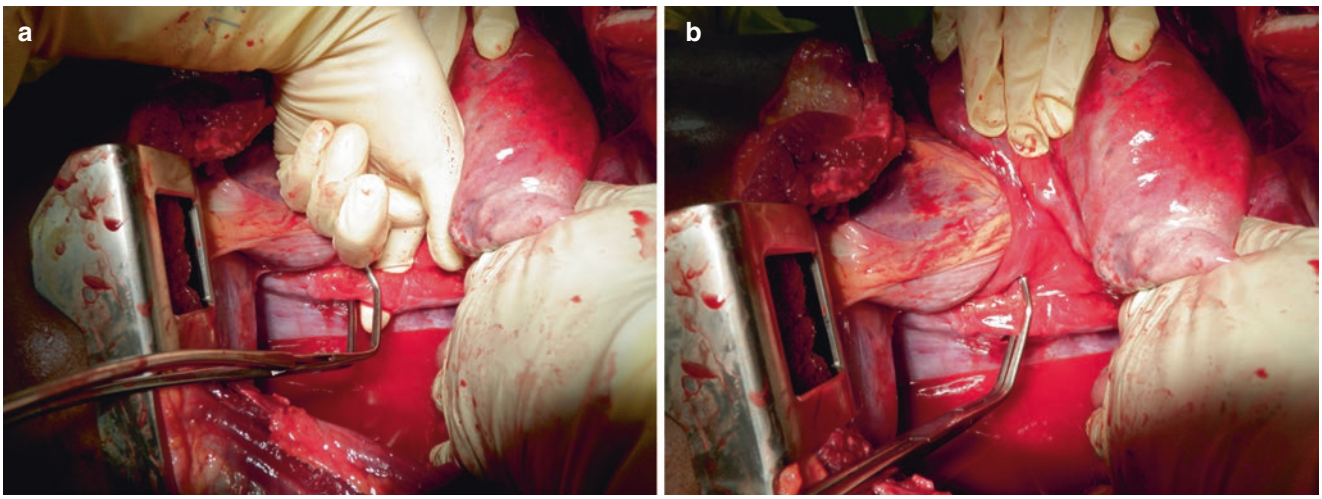

Fig. 27.11 (**a**) A vascular clamp (a Satinsky clamp is used here, although any large atraumatic vascular clamp can be used) is applied across the descending aorta, (**b**) followed by visual and tactile confirmation that the aorta is completely occluded

- Neglect of the mammary arteries, often divided during emergent thoracotomy and not briskly bleeding in the shock state, will result in intrathoracic hemorrhage if not tied off.

Suggested Reading

Jones RF. Resuscitative thoracotomy. In: Roberts JR, Hedges JR, editors. Clinical procedures in emergency medicine. 7th ed. Philadelphia: WB Saunders; 2019.

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