# Initial Safe Management of Cardiac Surgical Emergencies for the Non-Cardiac Anesthesiologist

Patients commonly present for urgent and emergent management of surgical conditions on the cardiac surgical service.

The Massachusetts General Hospital defines "**urgent**" as any case which must be started within 4 hours or the patient is at risk of loosing live, limb, or vision. An "**emergent**" case is defined as a case that must occur within 30 minutes or the patient is at risk of loosing the same. Many conditions that require cardiac surgical intervention may be either hemodynamically stable but rapidly progress to an unstable situation. Others are hemodynamically very labile or "unstable" but can be managed medically until all resources are available to proceed in a safe manner. It is often difficult to tell the difference between the two.

Emergent cardiac surgical cases will present in multiple areas throughout the medical system. These include the Cardiac Surgical Intensive Care Unit (CSICU), Cardiac Catheterization Suite, Emergency Department (ED), Electrophysiology Lab (EP), Labor and Delivery), and the hospital wards.

**Table XXX- Sites of Presentation of Cardiac Surgical Emergencies**

| Presentation Location | Condition/Situation |
|---|---|
| CSICU | Hemorrhage<br>Tamponade<br>Refractory ischemia and instability |
| Catheterization Suite | Coronary dissection<br>Aortic dissection<br>Tamponade<br>Device embolization |
| ED | Aortic dissection<br>Cardiac trauma/tamponade<br>Acute aortic injury<br>Transport to hospital |
| Electrophysiology Lab | Tamponade<br>Bleeding |
| Labor and Delivery | Pulmonary embolization |
| Wards | Hemorrhage<br>Post-operative cardiac arrest |

Emergency cardiac cases for calendar year 2018 were assessed. One-hundred twenty-five cases were booked as an "emergency". Sternal washout or exploration was the top indication followed by cannulation for extracorporeal membrane oxygenation (ECMO),

repair of aortic dissection, and emergency coronary artery bypass grafting. Most cases ECMO cannulation though were performed in locations other than the operating room leaving sternal exploration and aortic dissections by far the most common emergency cases performed in the cardiac operating rooms.

Table XXX- Cardiac surgical emergency procedures as the MGH (CY 2018)

| Procedure | Number (%) | Notes |
|---|---|---|
| Repair of aortic dissection | 24 (24.5%) | |
| Sternal debridement/washout/exploration for bleeding/hematoma evacuation | 44 (44.9%) | |
| Coronary artery bypass grafting | 7 (7.14%) | |
| ECMO cannulation | 5 (5.1%) | |
| Pulmonary embolectomy | 2 (2.04%) | |
| Aortic root replacement | 2 (2.04%) | |
| Pericardial window | 2 (2.04%) | |
| Minimally invasive mitral valve | 2 (2.04%) | |
| Impella change/reposition | 2 (2.04%) | |
| *Less than 1% each*<br>Heart transplant<br>Insertion of RVAD<br>Abdominal wound exploration<br>Groin exploration<br>LVAD exchange<br>Repair of aortic pseudoaneurysm<br>Resection of aortic valve mass<br>ECMO cannulation 1 | 8 (8.2%) | |
| | 98 | |

## Post-operative Cardiac Arrest

Arrest after cardiac surgery may be due to many different causes or combination of causes. Between 1-3% of the1 milion patients undergoing cardiac surgery in a year will experience a post-operative arrest (Ngaage 2009). Collapse is associated with a high mortality as well as infection and renal failure. Most arrests occur during the first 24 hours after surgery but some may occur beyond this period.

### Table XXX- Potential Cardiac Emergencies

| **Immediate Post-op** | **Sub-acute Post-op** | **Delayed** |
|---|---|---|
| 1st 12 hours | 1st 24 hours | >24 hours |
| Hemorrhage<br>Tamponade<br>Acute ischemia<br>Arrhythmia<br>Heart block<br>Electrolyte abnormality<br>Coronary air embolization<br>Drug errors<br>Pneumothrax<br>Post extubation respiratory failure | Hemorrhage<br>Tamponade<br>Stroke | Hemorrhage (wire removal)<br>Stroke<br>Tamponade<br>COPD exacerbation |

Pulmonary conditions are responsible for 30% of arrests (Ngaage 2009). These conditions should be managed with reintubation or appropriate management of ventilation and rarely require surgical intervention.

Cardiac conditions are the primary causes of arrest with ventricular fibrillation or tachycardia being the primary arrest mechanism in 70%, while asystole occurs in 17% and pulseless electrical activity in 13%. Repeat sternotomy is necessary in more than half of the patients (52%).

**Table XXX- Mode of Resuscitation After Post-operative Cardiac Arrest**

| Technique of Resuscitation | Frequency |
|---|---|
| Re-sternotomy | 52% |
| Reinstitution of bypass | 16% |
| Regrafting of vessels in ischemia area | 6% |
| Use of an IABP | 45% |
| Ventricular assist device use | 2% |

Most cardiac arrest situations will occur in the cardiac surgical intensive care unit (CSICU) setting where a skilled team is available to begin resuscitation efforts prior to return to the operating room.

**Table XXX- CSICU resuscitation efforts**

| Condition | Primary Resuscitation | Secondary resuscitation |
|---|---|---|
| Hemorrhage | Volume replacement<br>Coagulopathy correction | Bedside sternotomy |
| Tamponade | Hemodynamic support | Repeat sternotomy |
| Acute Ischemia | Hemodynamic support | Coronary angiography |
| Arrhythmia | Defibrillation/Cardioversion<br>Pacemaker support | Repeat sternotomy<br>IABP placement |
| Coronary air embolization | Trendelenberg<br>Hemodynamic support | IABP |

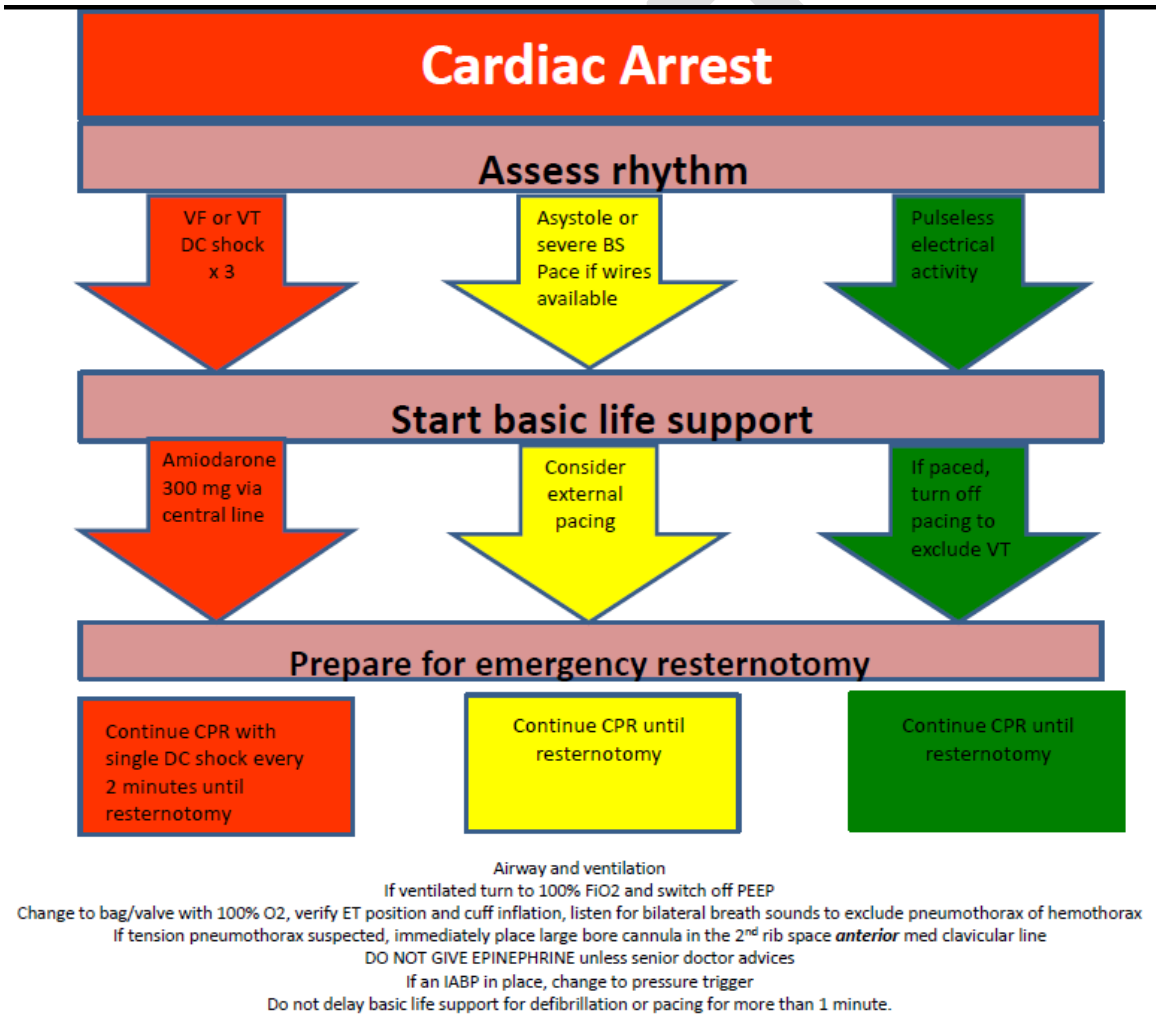
## Management of the Cardiac Surgical Emergency from the Cardiac Surgical Intensive Care Unit or Wards

Cardiac surgical conditions requiring management in the operating room are primarily due to hemorrhage, tamponade, or refractory hemodynamic instability or arrhythmia. Initial resuscitation follows the usual sequence of initiation of airway management and then initiation of breathing and oxygenation, simultaneous with or followed by initiation of a course of action to address circulatory inadequacy.

**Table XXX- Circulatory Resuscitation of Cardiac Surgical Patients**

| Technique of Resuscitation | Method |
|---|---|
| Assurance of adequate IV access | Large central or peripheral access |
| Correction of unstable arrhythmia | Defibrillation/Cardioversion<br>Appropriate pacemaker management<br>Correction of causes of PEA<br>Re-sternotomy |
| Initiation of hemodynamic support | Vasopressor or inotropic support |
| Administration of fluids | Lactated Ringers (LR) |

| | |
|---|---|
| | Normal Saline (NS) |
| Administration of blood products | Order blood cells, plasma, platelets |
| **Emergent Bedside ECHO**<br>Tamponade<br>Hypovolemia<br>Myocardial dysfunction | |
| Bedside surgical intervention? | Emergent bedside sternotomy<br>Chest exploration |
| Immediate Mechanical support? | IABP<br>ECMO |
| **Notify Operating Room of Surgical Emergency (#6810)** | |
| **Notify Cardiac Anesthesia Team** | |
| **If imminent surgical management in the operating room must occur immediately, the main operating room (MOR) team is notified** | |




## Emergency Transport to the Operating Room

Bedside management including emergent sternotomy may allow stabilization prior to transport and even buy enough time until the full cardiac care team can arrive. In addition to the cardiac anesthesiologists, specially trained nurses as well as the perfusion team.

**The safest location for continued management of a patient may be in the intensive care unit rather than the operating room if the appropriate team is not available.** The CSICU has an abundance of resources including nurses and cardiovascular intensivists to provide medical stabilization. Transport removes this support.

The operating room does provide high level support that cannot be delivered in the CSICU. In certain circumstances transport of a hemodynamically unstable patient is necessary especially if the trajectory of the condition is worsening and surgical management is the only intervention that may save the patient's life.

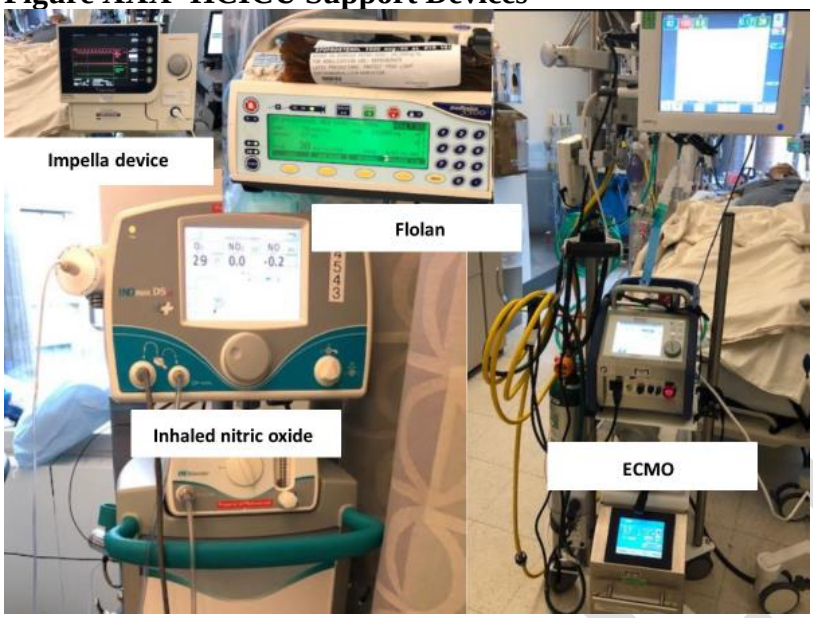
In certain circumstances, patients must immediately move to the operating room. A complete history and physician along with an informed discussion of the risks is ideal but often there is not enough time. In such a case, critical information can be obtained via the "AMPLE" namonic.

**Table XXX- Preparation for Emergent Transport to the Operating Room**

| Transport parameter | Action |
|---|---|
| OR availability | Assure that procedure is scheduled with the operating room |
| Initial OR transport notification | Operating room prepared<br>Nurses available<br>Perfusion team available or en route<br>Confirm cardiac anesthesia en route or in house |
| Monitors | No less than receiving on floor or ICU<br>Defibrillator available |
| Access | Assure large bore IV access available<br>Free flowing IV for bolus medication |
| Continuous medications | Assure medications are adequate for travel and beyond<br>Assure that vasopressors are adequate |
| Resuscitation medications | Assure bolus syringes of medications available |
| Ventilation | Notify respiratory therapy<br>Ambubag available for all transports<br>Transport ventilator<br>Adequate oxygen |
| Fluids | Extra crystalloids<br>Blood or FFP if available and potentially needed |
| Personnel | 2 individuals to push bed<br>1 individual to monitor patient<br>Perfusion to transport ECMO, VAD, IABP, Impella |
| Notification | Final notification that patient is en route to the OR |
| Post-departure actions | Send cooler back to blood bank |

Patients returning to the operating room after cardiac surgery are often receiving significant hemodynamic management and are commonly on other types of mechanical and respiratory support such as ECMO, VADS, Impella devices, Inhaled nitric oxide (iNO), and Inhaled prostaglandin (Flolan). These devices complicate transport and increase risk, especially when transport is urgent. The respiratory therapist will travel will all patients on Flolan or Inhaled nitric oxide (iNO). A perfusionist will travel with patients supported by an Impella device, ECMO, or IABP, or (VAD).

**Figure XXX- HCICU Support Devices**




**Specific emergencies**

**Cardiac tamponade**

Cardiac tamponade in cardiac surgical patients is most commonly due to either bleeding after surgery or associated with an aortic dissection. May also be seen after interventional procedures such as pulmonary vein isolation (PVI), MitraClip placement, or percutaneous coronary intervention (PCI).

Tamponade due to bleeding in the post-operative period may be circumferential but is more often focal associated with compression of the atria, ventricles, vena cava, or pulmonary veins. TEE is generally helpful by demonstrating small underfilled cavities or effusion.

Tamponade associated with PVI, PCI, or other interventional procedures are initially managed with catheter placement into the pericardium. Such effusions are generally more circumferential and may demonstrate the classic signs of **Beck's Triad** which includes hypotension with a narrowed pulse pressure, jugular venous distention, and muffled heart sounds.

**Image XXX- Transthoracic image of pericardial tamponade**

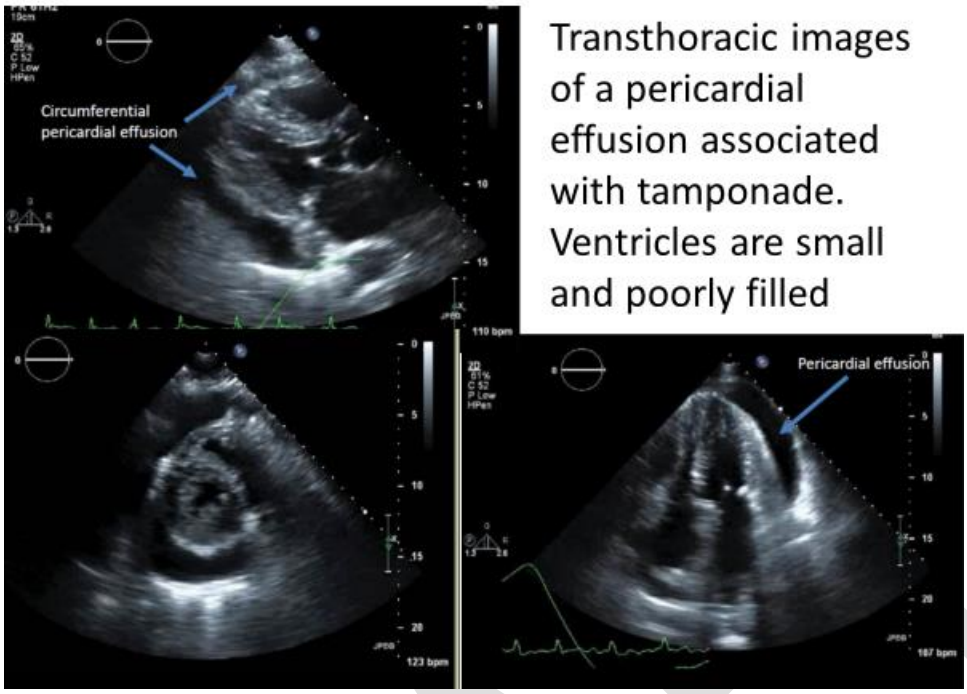
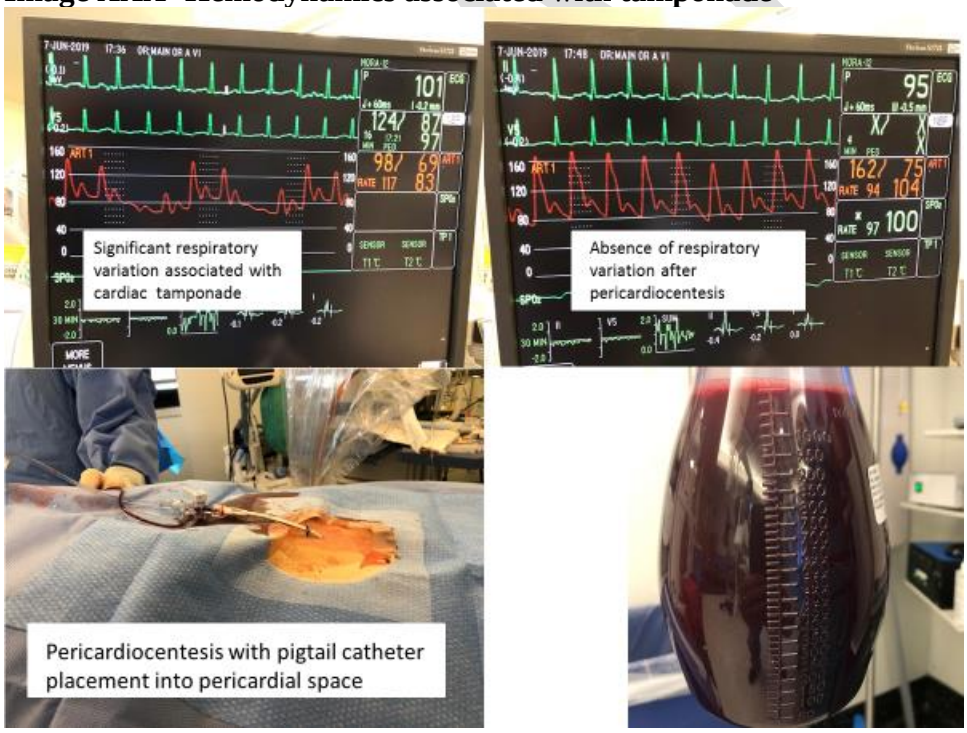



**Image XXX- Hemodynamics associated with tamponade**




**Additional Available resources**

There are many other resources available in addition to the cardiac anesthesiologist on call.

| Potential cardiac resources | Contact information |
|---|---|
| Cardiac anesthesia 2nd call | Beeper |
| Cardiac anesthesia resident | Beeper #21400 |
| Cardiac anesthesia fellow | Beeper |
| HCICU intensivist[1] | Blake 8<br>Ellison 9 |
| Ellison 4 intensivist[2] | Ellison 4 |
| Blake 12 intensivist[2] | Blake 12 |
| MOR anesthesiologists having done fellowships in cardiac recently | Kate Cohen, M.D.<br>Hovig Chitilian, M.D.<br>Marcos Vidal-Melo, M.D. |

1. Several HCICU intensivists are also cardiac anesthesiologists (Cudemus, Shelton, Lai, Wong, Crowley)
2. Alex Kuo is a cardiac anesthesiologist as is Abraham Sonny.

References:

1. Ngaage DL, Cowen ME. Survival of Cardiorespiratory Arrest After Coronary Artery Bypass Grafting or Aortic Valve Surgery. Ann Thorac Surg 2009;88:64-9.
2.

**Appendix 1 – Cardiac Surgical Emergency Checklist**

| Action | Notes |
|---|---|
| Confirm patient information | |
| Scan bracelet | |
| Order blood | |
| Establish Standard monitoring | 4 units RBCs<br>4 units FFP |
| R2 pads | |
| Establish large bore IV access | 14 g IV had higher flow rates than the side-port of the PSI<br>The MAC white port his higher flows if a Swan or TRIC is in place |
| Place arterial line on side of higher blood pressure or bilateral lines if time | |
| Consider need for placement of central line prior to induction | Presence of tamponade |
| Pre-operative Huddle critical information | Presence of tamponade or effusion<br>Coronary involvement or AI |
| Phenylephrine in line | |
| Induction with Etomidate | |