

The Role of Emergency Coronary Intervention During and Following Cardiopulmonary Resuscitation

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- Coronary intervention • Emergency medicine
- Cardiopulmonary resuscitation • Coronary angiography

The vast majority of patients with out-of-hospital cardiac arrest have underlying coronary artery disease. Autopsy studies have documented an 80% to 90% incidence of significant coronary disease in adults succumbing to sudden cardiac death.¹ Prospective studies of coronary angiography of those successfully resuscitated also show an incidence of coronary disease approaching 80%.² Acute coronary ischemia is a common trigger for out-of-hospital ventricular fibrillation cardiac arrest. Culprit lesions can be readily identified during coronary angiography immediately after resuscitation in 90% of those with ST elevation myocardial infarction (STEMI) and in 25% of those without STEMI.³

CARDIAC ARREST DURING CORONARY ANGIOGRAPHY AND PERCUTANEOUS CORONARY INTERVENTION

Coronary angiography remains the gold standard for diagnosing and treating coronary artery disease. Despite technological advances, cardiac catheterization carries a finite risk of morbidity and mortality. In a series of nearly 60,000 patients, the risk of all major complications from coronary angiography was less than 2%.⁴ As with any medical procedure, death is the most dreaded complication, but the incidence is low, estimated to be 0.1%.⁴ Although serious complications are rare, certain groups of patients are at higher risk. The stability of the patient before the

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procedure significantly influences outcome, with the highest risk associated with patients who are moribund (tenfold increase) or in shock (sixfold increase).⁵

The incidence of death with percutaneous coronary intervention (PCI) is estimated at 1% (range, 0.5%–1.4%).⁶ The incidence of cardiac arrest with PCI is more difficult to determine. Webb and colleagues⁷ reported that in 4366 consecutive PCI patients, 57 had a cardiac arrest, for an overall incidence of 1.3%. Cardiac arrest was defined as cardiovascular collapse requiring cardiac resuscitation with or without defibrillation. Nearly half (47%) occurred during the PCI, whereas 53% occurred later that same day after leaving the cardiac catheterization suite. The majority of patients had an initial tachyarrhythmia, including ventricular fibrillation (36%) or ventricular tachycardia (28%). Bradyasystolic rhythms were less common but were seen, including bradycardia (24%), asystole (8%), and pulseless electrical activity (PEA) (2%). Predictors of cardiac arrest included emergency interventions, such as during an acute myocardial infarction, and cardiogenic shock. Percutaneous intervention of both the left anterior descending and right coronary artery were more commonly associated with cardiac arrest than was PCI of the left circumflex artery. Coronary angiography was repeated for the majority who had a cardiac arrest after leaving the PCI suite. A significant proportion had a major side branch occlusion (38%), persistent no-reflow (32%), or acute stent thrombosis (25%). Tamponade from distal wire perforation, undetected while in the catheterization laboratory, was found in one patient (4%). The vast majority of cardiac arrests (98%) occurred during an emergent PCI setting. Cardiac arrest was exceedingly rare during elective PCI cases, occurring in only 0.02% of such patients. Cardiac arrest associated with PCI is, however, not benign. The subsequent 24-hour mortality rate was 63%. Those most likely to die are the elderly and those in whom the cardiac arrest is associated with shock, no-reflow, side branch occlusion, or intraprocedural arrest. Although the overall incidence of cardiac arrest with PCI is low (1.3%), the majority of those who do arrest subsequently do poorly.

PREVENTION OF CARDIAC ARREST DURING PCI

President Eisenhower once said, “In preparing for battle, I have always found that plans are useless but planning is indispensable.” Preinterventional planning is the single most important aspect of avoiding possible PCI complications including cardiac arrest. One needs to have a good understanding of the events that can lead to cardiac collapse and have an appropriate plan, including specific technology, should such a contingency be needed. Such technology should include functional defibrillators, temporary pacing equipment, circulatory support systems such as intraaortic balloon counterpulsation, and possibly the Impella (Abiomed) or extracorporeal membrane oxygenation systems.

TREATMENT STRATEGIES FOR CARDIAC ARREST DURING PCI

Several distinct scenarios can occur leading to cardiac arrest during PCI. Careful consideration of these circumstances before they occur can prepare one to recognize and appropriately treat each, despite the stress-filled environment when they do happen.

Hemodynamic Collapse

Sudden hypotension in the cardiac catheterization laboratory must be dealt with immediately if cardiac arrest is to be avoided. When troubleshooting abrupt hypotension, first make sure it is real. Check the position of the catheter through which the

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