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Background: We know that cardiac arrest is a devastating disease and that it occurs in approximately 400,000 Americans each year. In the few patients who achieve return of spontaneous circulation (ROSC) and survive past the pre-hospital stage, mortality rates range from 50 – 60% depending on which sources you read. Neurologic injury is the primary reason for mortality in cardiac arrest patients who do survive to hospital admission and while therapeutic hypothermia (TH) is now an established and recommended therapy to help improve survival and neurologic outcomes in cardiac arrest survivors, the mortality rate is still high in this population. Acute coronary syndrome (ACS) accounts for the majority of cases of cardiac arrest in adults and some recent studies have shown that early cardiac catheterization (CC) and immediate percutaneous coronary intervention (PCI) are associated with improved survival following cardiac arrest. However, many of the patients included in these studies had ST-elevation myocardial infarction (STEMI). There is already a Class 1 recommendation for early CC & PCI in the setting of STEMI following cardiac arrest, but the data on early CC in comatose post-arrest patients without STEMI is very limited. Post-resuscitation electrocardiogram (ECG) is often unreliable and lack of ST-elevation has a poor sensitivity for the diagnosis of acute coronary occlusion. Recently the American College of Cardiology/American Heart Association (ACC/AHA) proposed and published a new consensus statement an algorithm to stratify cardiac arrest patients who are comatose for CC activation. As part of this algorithm non-ST elevation myocardial infarction (NSTEMI) was added as an indication for CC activation.

What They Did:

- Determine if early CC is associated with improved survival in cardiac arrest patients due to ventricular arrhythmia who have ROSC and comatose when ECG evidence of STEMI is absent
- Retrospective observational study of a prospectively collected cohort of 754 comatose patients who survived to hospital admission after cardiac arrest
- Six large tertiary care medical centers in the United States
- Two groups:
 - Early Cardiac Catheterization
 - No Early Cardiac Catheterization

Inclusion:

- All patients ≥ 18 year so age who survived to hospitalization in a comatose state following cardiac arrest due to ventricular tachycardia/ventricular fibrillation (VT/VF)
- Patients receiving therapeutic hypothermia (TH) defined as 32 - 34°C maintained for 24h following ROSC

Exclusion:

- Patients with ECG criteria for STEMI

Definitions:

- Early Cardiac Catheterization = Catheterization performed either immediately upon hospital admission or during hypothermia treatment (i.e. 1st 24hours)
- Late Cardiac Catheterization = Catheterization performed at any other time during hospitalization (i.e. 24h after admission)
- Significant Coronary Lesions = Coronary Lesions with a $\geq 50\%$ angiographic luminal stenosis
- Acute Coronary Occlusion = Thrombolysis in Myocardial Infarction (TIMI) grade 0 or 1 flow, if there was angiographic evidence of thrombus at the site of occlusion, or by the ability to pass a guidewire easily through the occluded segment
- Median Follow Up Intervals = 5 months for patients treated with early CC and 6 months for all other patients

Outcomes:

- Primary: Survival to Hospital Discharge
- Secondary: Neurologic function of survivors at hospital discharge, left ventricular function at hospital discharge, survival to follow-up, and neurologic function at follow up (Neurologic function was determined using Cerebral Performance Category (CPC) Score)

Results:

- Of the 754 patients included in the study → 269 patients (35.7%) had cardiac arrest due to a ventricular arrhythmia without STEMI and treated with TH
 - 122/269 (45.3%) received early CC
 - 147/269 (54.6%) did not receive early CC
 - 41/147 (27.9%) received late CC
 - 106/147 (72.1%) did not receive CC at any time
- Survival to Hospital Discharge:
 - 65.6% with early CC
 - 28.6% without early CC
- Rate of Good Neurologic Outcome at Hospital Discharge
 - 92.5% with early CC
 - 83.3% without early CC
- Multivariate Analysis showed a significant decrease in the risk of death associated with early CC vs no early CC (OR 0.35, 95% CI 0.18 – 0.70; p – 0.003)
- After excluding patients treated with late CC, the association was even more pronounced for the risk of death with early CC vs no CC at all (OR 0.14, 95% CI 0.06 – 0.32; p<0.001)
- LV Systolic Function at Hospital Discharge
 - No difference between pts with early CC vs no early CC

- Survival to Follow Up With Favorable Neurologic Outcomes:
 - 60% with early CC
 - 39.7% without early CC
- Acute coronary occlusion:
 - 26.2% with early CC
 - 29.3% with late CC
 - No difference in the rate of PCI between the two groups (32.8% vs 39.0%)
- Patients Treated with Early Cath (N = 122):
 - 40/122 (33%) had successful PCI
 - 28/40 (70%) of interventions were for acute coronary occlusion
 - 18/40 (45%) had initial TIMI flow <3
 - 35/40 (87.5%) had culprit lesions of ≥70% stenosis
 - 40/40 (100%) had at least one nonculprit lesion of ≥70% stenosis
 - 12/40 (30%) had chronic total occlusions
- Early Cath with PCI vs No PCI:
 - Survival to Hospital Discharge: 60% vs 68.3%
 - CPC 1 – 2 at Hospital Discharge: 57.5% vs 62.2%
 - No statistical difference between PCI and no PCI

Limitations:

- At baseline, the patient populations were not balanced. Patients receiving early cardiac catheterization were more likely to be in shock (i.e. sicker), but also receive more aggressive treatment (i.e. Mechanical LV support devices, aspirin, antithrombin agents, Thienopyridine agents, and Glycoprotein IIb/IIa inhibitors)
- This is a retrospective observational study, which means many confounders may not have been taken into account (i.e. quality of CPR, time to ROSC, time to defibrillation, etc.)

Discussion:

- Prior studies looking at survival and neurologic function in comatose cardiac arrest patients who received early CC had a large portion of STEMI patients in them (i.e. 33 – 34% of study cohort). This current study excluded STEMI patients and therefore focused on patients with cardiac arrest without STEMI.
- One of the more significant findings of this study was the prevalence of acute coronary occlusions identified. 27% of patients had an acute coronary occlusion identified at the time of CC, which means one out of every 3 – 4 patients without STEMI on the post-resuscitation ECG has an acute coronary artery occlusion. The authors go on to say due to the significant rate of coronary artery disease discovered in patients who suffer cardiac arrest following ventricular arrhythmias and the poor sensitivity of the post-

- resuscitation ECG, a reasonable strategy may be to incorporate early CC in the routine care of this group of patients.
- Its interesting that of the patients undergoing early cardiac catheterization, the outcomes in patients with PCI were not better when compared to those who received early catheterization and no PCI. In other words patients got a heart catheterization, but no intervention was performed. **So maybe early CC results in improved outcomes for reasons other than early PCI (i.e. a greater intensity of care)**
 - Finally, this study is hypothesis generating, and not conclusive evidence. We still need confirmation of these findings in a prospective, randomized trial

Author Conclusion: In comatose survivors of cardiac arrest without STEMI who are treated with TH, early CC is associated with significantly decreased mortality. The incidence of acute coronary occlusion is high, even when STEMI is not present on the post-resuscitation ECG.

Clinical Take Home Point: In comatose survivors of cardiac arrest from ventricular arrhythmia, without STEMI on ECG, who are treated with TH, early CC is associated with better survival to hospital discharge with good neurologic outcomes, but a prospective, randomized trial is still required to confirm these findings.

References:

1. Hollenbeck RD et al. Early Cardiac Catheterization is Associated With Improved Survival in Comatose Survivors of Cardiac Arrest Without STEMI. Resuscitation 2014; (85) 1: 88 – 95. [PMID: 23927955](#)

For More Thoughts on This Topic Checkout:

- Scott Wieters on REBEL EM: [Beyond ACLS – From CPR to Cath - The New ACC/AHA Cardiac Arrest Algorithm](#)