



## ADULT CARDIAC SURGERY:

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# Clinical Characteristics and Outcomes of Patients With Myocardial Infarction and Cardiogenic Shock Undergoing Coronary Artery Bypass Surgery: Data From The Society of Thoracic Surgeons National Database

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**Background.** Acute myocardial infarction complicated by cardiogenic shock (AMI-CS) is associated with substantial mortality. We evaluated outcomes of patients in The Society of Thoracic Surgeons Adult Cardiac Surgery Database who underwent coronary artery bypass graft surgery (CABG) in the setting of AMI-CS.

**Methods.** All patients with AMI-CS who underwent nonelective CABG or CABG with ventricular assist device implantation within 7 days after myocardial infarction were enrolled. The primary analysis sample consisted of patients who underwent surgery between June 2011 and December 2013. Baseline characteristics, operative findings, outcomes, and the utilization of mechanical circulatory support (MCS) were assessed in detail in this population. We also evaluated trends in unadjusted mortality for all patients undergoing CABG or CABG with ventricular assist device for AMI-CS from January 2005 to December 2013.

**Results.** A total of 5,496 patients met study criteria, comprising 1.5% of all patients undergoing CABG

during the study period. Overall operative mortality was 18.7%, decreasing from 19.3% in 2005 to 18.1% in 2013 ( $p < 0.001$ ). Use of MCS increased from 5.8% in 2011 to 8.8% in 2013 ( $p = 0.008$ ). Patients receiving MCS had a high proportion of cardiovascular risk factors or high clinical acuity. Patients requiring preoperative and patients requiring intraoperative or postoperative MCS had operative mortality of 37.2% and 58.4%, respectively. Patients undergoing CABG as a salvage procedure had an operative mortality of 53.3%, and a high incidence of reoperation (21.8%), postoperative respiratory failure requiring prolonged ventilation (59.7%), and renal failure (18.5%).

**Conclusions.** Most patients undergoing CABG for AMI-CS have a sizeable but not prohibitive risk. Patients who require MCS and those undergoing operation as a salvage procedure reflect higher risk populations.

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Cardiogenic shock is the primary cause of hospital death after myocardial infarction (MI), with an associated mortality of roughly 40% [1]. Revascularization can improve survival after cardiogenic shock from MI [2]. In the Should We Emergently Revascularize Occluded

Coronaries for Cardiogenic Shock (SHOCK) trial, patients undergoing coronary artery bypass graft surgery (CABG) had outcomes similar to those of patients undergoing PCI despite having more substantial coronary artery disease and higher rates of diabetes mellitus [3]. Despite the benefit of CABG, this therapy remains underutilized in these critically ill patients [4].

Mehta and colleagues [5] reported the outcomes of patients in The Society of Thoracic Surgeons (STS) Adult Cardiac Surgery Database (ACSD) who underwent

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**Abbreviations and Acronyms**

- ACSD = Adult Cardiac Surgery Database
- AMI-CS = acute myocardial infarction complicated by cardiogenic shock
- CABG = coronary artery bypass graft surgery
- ECMO = extracorporeal membrane oxygenation
- IABP = intraaortic balloon pump
- LVAD = left ventricular assist device
- LVEF = left ventricular ejection fraction
- MCS = mechanical circulatory support
- MI = myocardial infarction
- PCI = percutaneous coronary intervention
- STS = The Society of Thoracic Surgeons
- VAD = ventricular assist device

CABG in the setting of AMI-CS between 2002 and 2005. The operative mortality ranged from 20% for isolated CABG to 33% for CABG plus valve surgery and 58% for CABG plus ventricular septal repair. Despite high mortality primarily due to pump failure, less than 3% of patients with shock received a left ventricular assist device (LVAD) [5].

Since 2005, there have been several major changes in the management of patients with AMI-CS. These include increased utilization of drug-eluting stents, an increase in the number of hospitals with 24-hour catheterization laboratory availability, new anticoagulant and antiplatelet agents with improved safety profiles, and improvements in extracorporeal membrane oxygenation (ECMO) and percutaneous and surgical ventricular assist device (VAD) technology. The utilization of percutaneous MCS devices has increased rapidly, with a 1,511% increase from 2007 to 2011 [6]. Outcomes after VAD implantation for post-MI cardiogenic shock and postcardiotomy shock have also improved [7].

The purpose of this study was to evaluate clinical characteristics and current outcomes of patients with AMI-CS undergoing CABG, with a specific emphasis on the utilization of MCS and associated outcomes.

**Material and Methods**

*Data Source*

The STS ACSD is a multicenter registry for adult cardiac surgery. It contains more than 5 million cardiac surgical records and captures 95% of all cardiac surgical procedures performed in the United States. The formation, rationale, and methodology of the STS ACSD have been described [8, 9].

*Patients*

The study population included patients in the STS ACSD who had a recent MI (within 7 days before the procedure) and cardiogenic shock and underwent nonelective CABG or CABG with VAD implantation. The primary analysis sample consisted of patients who underwent surgery between July 2011 and December 2013. The 2011 start

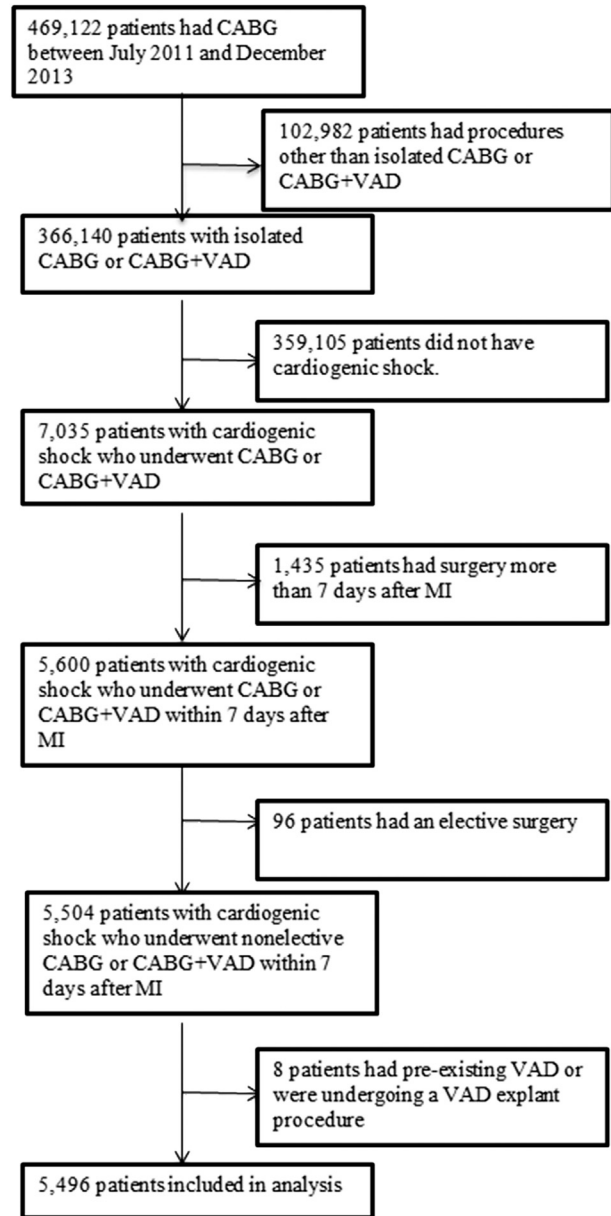


Fig 1. Patient selection. (CABG = coronary artery bypass graft surgery; MI = myocardial infarction; VAD = ventricular assist device.)

date was chosen to coincide with version 2.73 of the STS data collection form, which first started collecting detailed data on catheter-based MCS and ECMO. We also evaluated patients who had surgery for the same indications between 2005 and 2013 solely to determine trends in unadjusted mortality. Exclusion criteria included patients with concomitant surgeries, preexisting LVAD, and post-MI complications such as mitral regurgitation, free wall rupture, or ventricular septal rupture (Fig 1).

*Data Definitions*

Cardiogenic shock is defined as the patient being, at the time of procedure, in a sustained (more than 30 minutes)

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