Cardiogenic Shock: Limitations of Current Device and Drug Treatment

Written by Mary Mosley

Cardiogenic shock (CS) develops in about 6% of patients who suffer an acute myocardial infarction (AMI), with a relative incidence of 1 in 40 AMI patients [American Heart Association. *Heart Disease and Stroke Statistics–2011 Update*. 2011]. The rate of mortality associated with CS after AMI continues to remain at about 45% to 50%, unchanged from 1997 to 2006, despite the increased use of an intra-aortic balloon pump (IABP) and percutaneous coronary intervention (PCI) and the decreased use of thrombolysis and coronary bypass surgery [Jeger RV et al. *Ann Intern Med*. 2008].

The time to intervene is within 90 minutes to reverse CS or the opportunity to repair the heart is lost, based on physiological responses to CS, stated Ramesh Daggubati, MD, East Carolina Heart Institute at Vidant Medical Center, East Carolina University, Greenville, North Carolina, USA. A device for hemodynamic (HD) support should be considered when a moderate dose of inotropes is needed, said Dr Daggubati. None of the most commonly used devices (eg, IABP, TandemHeart, and Impella), however, have been shown to reduce mortality, despite their ability to improve hemodynamics. The limited beneficial effects and the increased side effects associated with the current drugs and devices to treat CS are summarized in Table 1.

The lack of a mortality benefit with IABP was shown in the IABP SHOCK II study [Thiele H et al. *Lancet*. 2013] and in a meta-analysis of studies conducted in the 1990s comparing it to no IABP [Sjauw KD et al. *Eur Heart J*. 2009], which also showed that mortality was about 6% higher with IABP in patients who underwent PCI, based on pooled data from the National Registry of Myocardial Infarction 2 and the Amsterdam Medical Center Cardiogenic Shock registries. IABP increased the risk of stroke by 2% (95% CI, 0 to 4; $P = .03$) and bleeding by 6% (95% CI, 1 to 11; $P = .02$), according to this meta-analysis.

HD support with IABP remains controversial and is being challenged because of the lack of evidence of benefit, stated Dr Daggubati, and the new percutaneous left-ventricular assist devices (TandemHeart, Impella) provide better HD support than IABP but do not improve

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Table 1. The Advantages and Limitations of Current Drug and Device Treatments for Cardiogenic Shock

	Inotropes	IABP	ECMO	TandemHeart	Impella	Surgical VAD
Advantages						
Flow (L/min)	< 0.5	0.5	4	3.5	2.5–5.0	6.0
Coronary perfusion	↑	↑↑	—	—	↑↑	↑↑
LVEDP	↑	↓	↑↑↑↑	↓↓	↓↓↓	↓↓↓↓
Limitations						
Arrhythmia	+++	—	—	—	—	—
Stroke	—	++	++	+	+	+++
Limb ischemia	NA	+	+++	++	+	NA
Bleeding	NA	++	++++	+++	+/++	++++
Cost	$	$	$$$	$$$	$$$	$$$$$

ECMO, extracorporeal membrane oxygenation; IAPB, intra-aortic balloon pump; LVEDP, left-ventricular end diastolic pressure; NA, not applicable; VAD, ventricular assist device.

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mortality. In the ISAR-SHOCK study, the Impella LP 2.5 device versus IABP significantly improved the primary end point of cardiac index (0.49 vs 0.11 L/min/m^2, respectively; $P = .01$), but mortality was similar (log-rank $P = .97$) [Seyfarth M et al. *J Am Coll Cardiol.* 2008].

The timing of mechanical support, however, may lead to improved outcomes. The preintervention placement of an IABP compared with no IABP or an IABP placed after the intervention in the CS group significantly reduced the incidence of ventricular fibrillation ($P = .02$), cardiopulmonary arrest ($P = .01$), and total events in the catheterization laboratory ($P = .0009$) [Brodie BR et al. *Am J Cardiol.* 1999]. A similar result was found in the Impella registry, stated Dr Daggubati, and the pre-intervention approach is being studied in the upcoming TandemHeart to Reduce Infarct Size Trial [TRIS Trial; NCT02164058]. Implementation of a CS protocol with quick escalation of percutaneous ventricular assist devices has been shown to reduce mortality of in-hospital CS in a small registry of 32 patients from 44% to 24%. Dr Daggubati presented these data at the Society of Cardiovascular and Angiography Interventions national meeting in May 2014.

The management of CS with circulatory support will evolve with new paradigm shifts and treatment protocols as technology evolves, but better identification of the patients most likely to benefit based on stronger clinical evidence is needed.

Stress ECHO: Strain and Speckle Tracking in Clinical Practice

Written by Mary Mosley

Stress echocardiography (ECHO) has a slightly higher specificity compared with stress nuclear testing and stress electrocardiography (ECG), according to Hossam El-Gendi, MD, Essex Cardiothoracic Centre, Essex, United Kingdom. A retrospective review that he conducted of 1000 patients showed that stress ECHO better defined the probability of coronary artery disease than exercise treadmill testing [Hopkinson SA, El-Gendi H. 2012].

Exercise ECG is no longer performed in the United Kingdom because it is seen as more harmful than beneficial, he stated. Exercise ECG compared with coronary angiography had a wide variability in its mean sensitivity (68%; range, 23 to 100) and mean specificity (77%; range, 17 to 100) in a meta-analysis of 147 consecutive studies with 24 074 patients conducted in the late 1980s.

Stress ECHO is limited to wall motion analysis, which captures only 30% of myocardial function, but determining the rate of strain between 2 points in the myocardium provides complementary data to determine the overall myocardial function. Longitudinal strain is an effective tool to evaluate the true systolic function of patients, for example in hypertrophic cardiomyopathy, which is characterized by a normal ejection fraction and decreased (by ≤ 20%) global longitudinal strain. Prof El-Gendi stated that speckle tissue tracking is reproducible, has less intraobserver and interobserver variability, and is a useful approach to judge ventricular function and rate of strain.

Automated function imaging, based on 2D strain technology, has been documented to quantify myocardial motion and deformation under rest conditions and is the subject of global collaborative research to determine its best use to enhance clinical decision making. Automated function imaging provides a rapid, reproducible, quantitative tool for the assessment of segmental and global wall motion, said Prof El-Gendi.

Furthermore, using speckle tissue tracking with stress ECHO is simple and can be used in daily practice to answer common clinical questions, stated Prof El-Gendi. In patients with cardiac resynchronization therapy, it provides more information about left ventricular synchrony and performance, and atrioventricular timing, to better manage hemodynamics in patients with heart failure. It can be used to assess coronary arteries, ischemia in the left anterior descending artery and inferior of the myocardium, left ventricular hypertrophy (LVH), hypertrophic obstructive cardiomyopathy, non-ischemic cardiomyopathy, and cardiac amyloid. The strain presentation in LVH is characterized by a decrease in the basal strain segments, normal apical segments, and a strain bulls-eye "donut."

Stress ECHO with speckle tissue tracking is an emerging tool that should be used in clinical practice to master it, urged Prof El-Gendi, because it has opened the window to evaluate the myocardium from the inside to the outside.

Health Care Quality Improvement Measures: Perspective From the Cath Lab

Written by Mary Mosley

Although operator proficiency is important in the catheterization laboratory (cath lab), regular monitoring and assessment of other indicators are important to ensure quality health care delivery. Hany Eteiba, MD, Glasgow Royal Infirmary, Glasgow, Scotland, outlined 5 types of quality indicators encompassing the measurement and