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Stunned: A Rare Case of Bi-Pella as a Bridge to Recovery for Biventricular Failure in the Setting of Myocardial Stunning

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Introduction

Myocardial stunning (MS) is characterized by prolonged post-ischemic ventricular dysfunction that occurs after brief periods of nonlethal ischemia. Stunned myocardium has been described following thrombolytic therapy, percutaneous coronary intervention (PCI) and coronary artery bypass grafting (CABG) [1].

Leading factors that contribute to MS are myocardial reperfusion injury following free radical formation and altered calcium flux with calcium overload and myofilament desensitization [1]. While cardiac ATP levels demonstrate biochemical stunning after 15 minutes of coronary artery occlusion, a gradual recovery of myocardial contractility can take up to 72 hours post-reperfusion [1,2].

We report the first documented case of cardiogenic shock after CABG due to myocardial stunning that was successfully treated with biventricular impella for hemodynamic support as a bridge to recovery.

Case Description

A 72-year-old male with a past medical history of essential hypertension, hyperlipidemia and GERD presented to the emergency department (ED) complaining of intermittent heartburn, the symptoms were aggravated by physical exertion and laying flat. He took omeprazole once a day with minimal relief. In the ED the ECG showed normal sinus rhythm, no ST/T wave changes, his initial troponin I was 2.380ng/mL (reference 0.034) and peaked at 7.930ng/mL.

Baseline echocardiogram (ECHO) was remarkable for LVEF of 45% (Figure 1). Patient underwent an early invasive left heart catheterization that was remarkable for severe multivessel coronary artery disease with 99% stenosis of the left main coronary artery (Figure 2 and 3). Cardiothoracic surgery was consulted, and he underwent a 3 vessel CABG procedure with LIMA-LAD, RIMA-PDA and SVG-OM.

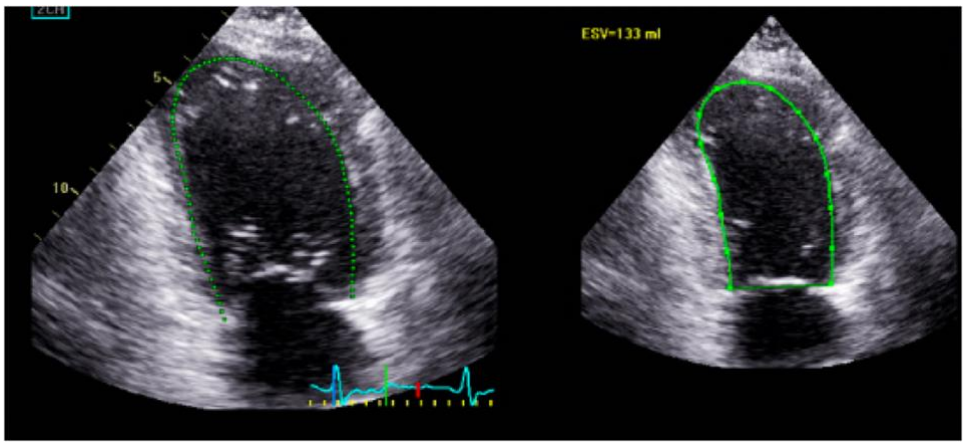


Figure 1: Echocardiographic evidence of reduced ventricular systolic function prior to CABG.

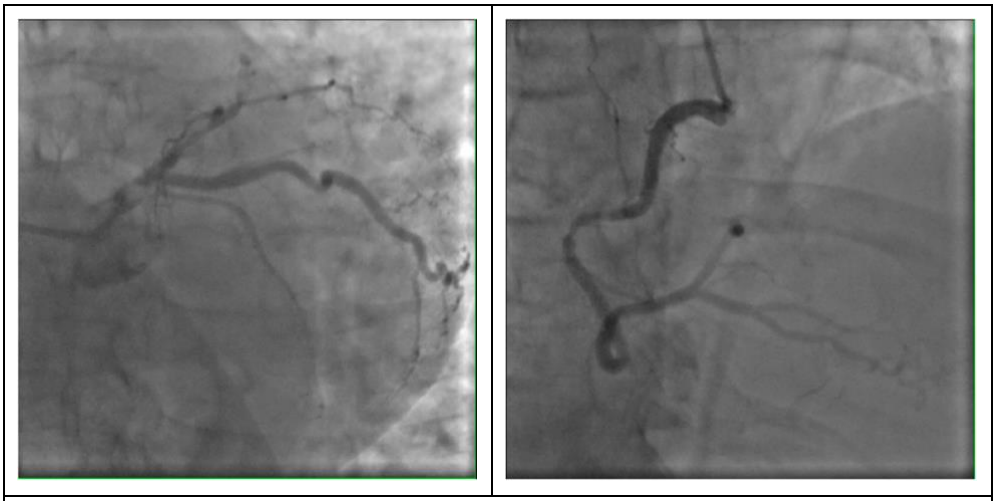


Figure 2 and 3: Left heart catheterization demonstrating severe multivessel coronary artery disease with involvement of right coronary and left main coronary artery.

Following CABG, the patient developed cardiogenic shock with echocardiographic evidence of an acute reduction in LVEF 10-15% with mid anterior, mid anterolateral, apical lateral left ventricular wall segment akinesis and mid anteroseptal, mid inferoseptal, apical septal and apical left ventricular wall dyskinesis (Figure 4). Right ventricular dysfunction evidenced by TAPSE 11mm. Left and right heart catheterization demonstrated bypass patency. Right catheterization showed RA 23mmHg, RV 22mmHg, mPA 34mmHg, PCWP 22mmHg, CVP/PCWP was 1.04, PAPI 1.3. The findings were consistent with biventricular shock, and an Impella CP and RP ventricular assist devices (ABIOMED) were implanted into the left and right ventricle respectively for hemodynamic support (Figure 5 and 6). Following multiple days of multidisciplinary management, Impella device support and vasopressors were weaned and removed on day 5.

Repeat ECHO demonstrated an improved LVEF of 55% (Figure 7). Patient was discharged hemodynamically stable with recommendations to undergo cardiac rehabilitation and follow up with cardiology.

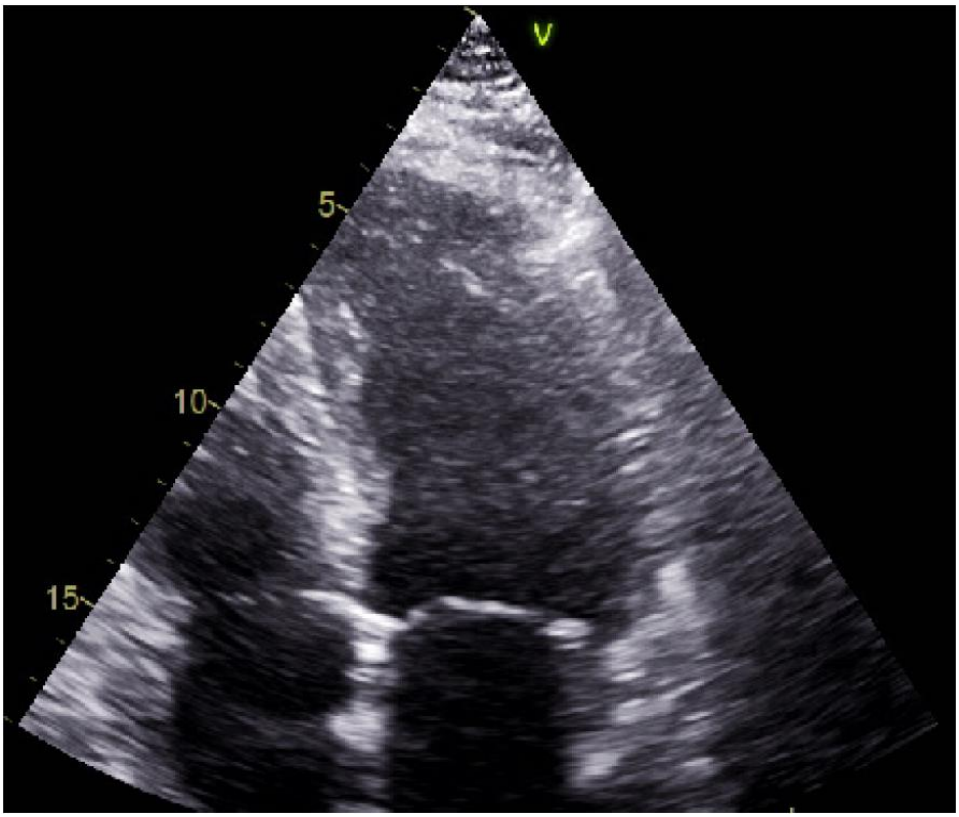
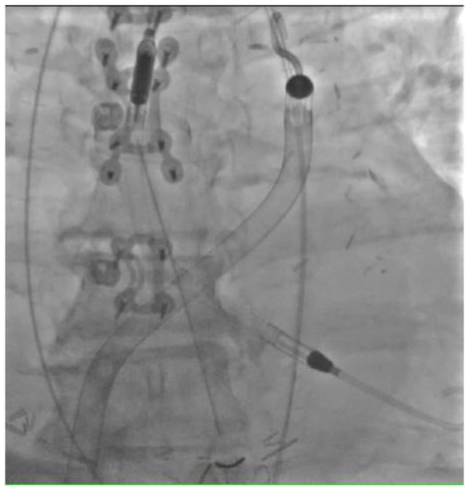


Figure 4: Echocardiographic evidence of systolic dysfunction following CABG with LVEF approximately 10-15%.



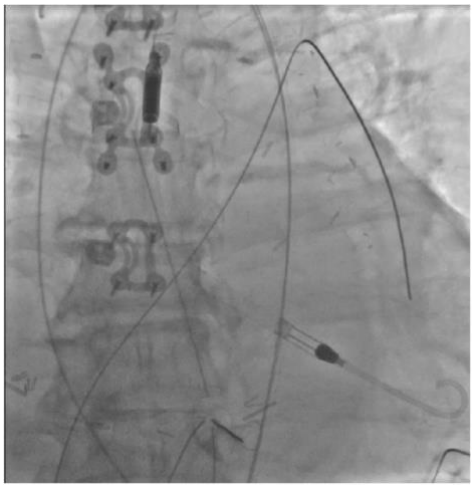


Figure 5 and 6: Implantation of bilateral Impella CP and RP devices for biventricular support in the setting of biventricular cardiogenic shock.

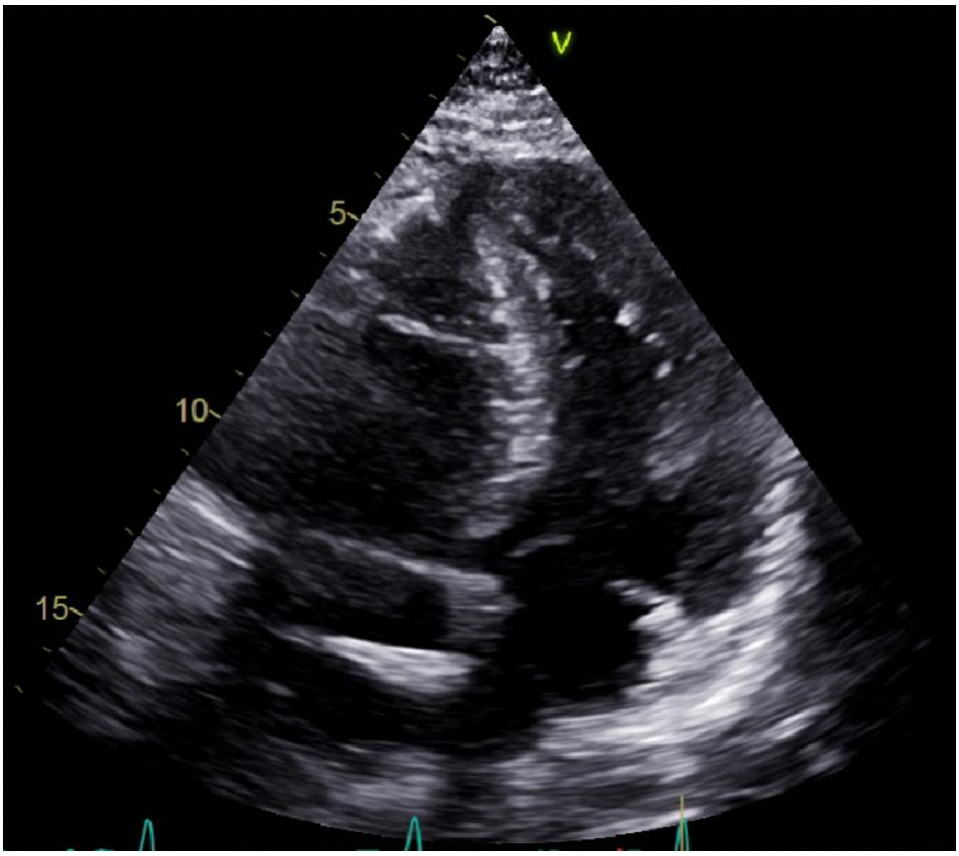


Figure 7: Echocardiogram prior to discharge demonstrating improved left ventricular systolic function after removal of bilateral impella ventricular support devices, LVEF approximately 55%.

Discussion

Reperfusion therapy can lead to a transient post-ischemic contractile and biochemic dysfunction. Myocardial stunning was initially associated with brief periods of ischemia without histologic evidence of cell death; studies have now shown that this phenomenon can also occur following myocardial infarction [1].

There is no guideline-based management for stunned myocardium. Given that myocardial stunning is a transient phenomenon, the medical management should focus on the treatment of underlying ischemic tissue. Ionotropic agents along with the use of mechanical circulatory support (MCS) can temporarily aid in ventricular unloading, hemodynamic support, and end-organ perfusion [3].

Acute ventricular unloading with the use of percutaneous ventricular assist devices (pVAD) is a viable approach to limit cardiac expenditure, protect against reperfusion injury, promote myocardial salvage, limit infarct size and reduce ventricular remodeling in the setting of acute myocardial injury. Circulatory support by pVAD can bridge patients through or hasten recovery from myocardial stunning via hemodynamic support until native heart function can be recovered [4].

Biventricular support with the Bi-pella approach provides multiple advantages including; individualized monitoring of biventricular function and the ability to extract one device at a time in accordance with ongoing univentricular or biventricular support requirements. Given the percutaneous nonsurgical method of implantation, early ambulation after bi-pella removal is a favorable advantage that can lead to the early initiation of cardiovascular rehabilitation and physical therapy [5].

Our case highlights how MCS with the use of biventricular Impella devices can be a safe and effective therapeutic intervention for biventricular failure in the setting of myocardial stunning.

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