EDITORIAL COMMENT
Intra-Aortic Balloon Counterpulsation in Acute Myocardial Infarction: Too Few or Too Many?*

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The concept of counterpulsation was introduced over four decades ago by Clauss et al. (1) and adapted to intra-aortic balloon pumping (IABP) by Moulopaulus et al. (2) in 1962, and it remains the most common mode of cardiac assist. Intra-aortic balloon counterpulsation (IABCP) was first introduced into clinical practice by Kantrowitz et al. (3) in 1968 for the treatment of cardiogenic shock. Initially, the 12F to 14F intra-aortic balloon (IAB) catheter required surgical insertion via a dacron graft sutured to the femoral artery. In 1979, the IAB was adapted for percutaneous insertion by Bregman and Casarella (4), and this was followed in the early 1980s by a dual-lumen, wire-guided, smaller catheter device which could be placed in 5 min with significantly improved insertion success and reduced vascular complications (5–8). Refinements have reduced the catheter size to 8F and 9F for 30- to 50-cc balloons, and technically advanced consoles can rapidly shuttle the helium gas with automatic timing.

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The physiologic principle of counterpulsation is a rapid decrease in intra-aortic pressure synchronized to left ventricular ejection followed by a rapid increase in intra-aortic pressure during left ventricular isovolumic relaxation. Impedance to left ventricular ejection is reduced (systolic unloading), decreasing afterload, and diastolic pressure is increased (diastolic augmentation) which improves coronary perfusion pressure. Cardiac work is therefore reduced and myocardial oxygen demand is decreased with concomitant increase in myocardial oxygen supply. These physiologic effects may be especially beneficial in patients with acute myocardial infarction (AMI) and cardiogenic shock.

Intra-aortic balloon counterpulsation was initially used for the treatment of patients with cardiogenic shock and left ventricular pump failure (9). However, despite improvements in hemodynamics, with increased cardiac output, decreased pulmonary capillary wedge pressure, improved arterial pressure, and improved urine output, results of IABCP alone in cardiogenic shock were disappointing (10,11). Subsequent studies of patients with cardiogenic shock supported with IABP, followed by early angiography and myocardial revascularization, when feasible, showed improved survival (12). Patients with AMI and cardiogenic shock treated with thrombolitics and IABP also appeared to have improved outcomes (13). Additionally, patients with mechanical complications of AMI (ventricular septal defect and acute severe mitral regurgitation) and patients with refractory unstable angina undergoing revascularization had clear benefit (14,15).

The indications for IABCP in AMI expanded to include support of severely ill patients during acute cardiac catheterization and myocardial revascularization both percutaneous and surgical (16). Intra-aortic balloon counterpulsation is also used to support patients with unstable angina and depressed cardiac function undergoing cardiac surgery during induction as well as weaning from cardiopulmonary bypass after myocardial infarction.

In this issue of the Journal, Stone et al. (17) present registry data on the utilization and outcomes of IABCP in AMI. Importantly, this is a very large database that provides valuable insight into IAB use in AMI patients while recognizing the limitations of a registry study. The American College of Cardiology/American Heart Association Task Force class 1 indications of IABP in AMI (cardiogenic shock, mechanical complications of AMI, intractable hemodynamically unstable ventricular arrhythmias, and refractory post myocardial infarction angina) account for about half the use of IABP in this registry, and support for cardiogenic shock is appropriately most common. Surprisingly, support for high-risk catheterization and angioplasty is nearly as frequent (27.3 vs. 27.2%, respectively). The need for this type of support should be reduced with the use of a new generation of non-ionic, low osmolar, X-ray contrast agents, which have reduced hemodynamic and ischemic changes during angiography. In addition, technical advances in guide wires, balloons, stents, and pharmacologic, plus increasing expertise in the intervention of the complex coronary lesions significantly reduces the need for mechanical assistance in the treatment of patients with AMI. Perhaps the reassurance of mechanical hemodynamic support influences the more frequent the use of IABP in this setting.

The hemodynamic effects of IABCP are generally dependent on the patient subset with those in greatest need (cardiogenic shock) having the most benefit, whereas the subset with stable hemodynamics has little change because of autoregulation. Use of IABCP in shock patients should certainly be complemented with complete hemodynamic monitoring to optimize fluid and pharmacologic management.

The serious complication rate of IABP use (severe access site bleeding, major limb ischemia, amputation, vascular
surgery, organ infarction, and IABP-induced mortality) in this registry is extremely low. Anticoagulation, small catheter size, guide wire insertion, and judicious use in patients with peripheral vascular disease are likely contributors to these good results. Pre-insertion abdominal and iliofemoral angiography is often performed to assess feasibility of insertion and to select insertion site, which also minimizes complications. Unfortunately, the registry does not reflect the frequency of patients who had indications for IABCP but had contraindications to insertion.

In this registry, the high revascularization rates in patients treated with IABP are consistent with current practice of AMI patient care and improved outcomes of specific patient subsets such as those with shock. The ability to revascularize acutely ill patients with AMI quickly and safely contributes to this approach in patient care.

Essential to the care of patients with AMI is the timely diagnosis and early treatment with an appropriate reperfusion strategy. The astute clinician with the aid of electrocardiographic, hemodynamic, and echocardiographic information can quickly identify the high-risk and cardiogenic shock patients who may benefit from IABCP support. Despite the recognized benefit of mechanical support in AMI shock, IABP was placed in only 22% (68 of 310 patients) of AMI shock patients in the Global Utilization of Streptokinase and Tissue Plasminogen Activator for Occluded Coronary Arteries (GUSTO I) study, reported by Anderson et al. (18). Alternatively, in high-risk patients with AMI treated with primary angioplasty in a randomized study, IABP use prophylactically did not reduce infarct-related artery reocclusion or reinfarction, nor did it promote recovery or improve clinical outcomes (19). The use of IABP support for angiography and intervention in the “high-risk” AMI patient may offer benefit not easily measured or detected, such as less hypotension, ischemic electrocardiogram changes, and pain during the procedure for the patient and reduced stress for the interventionalist and cardiac catheterization laboratory staff. Important issues such as duration of IABCP support in cardiogenic shock to optimize recovery of cardiac function and survival are yet to be defined. The goal of AMI patient care is to improve clinical outcome, and the use of an IABP should be considered when the benefits of counterpulsation are desirable; however, this is but one important component in the overall management of patients with AMI. Clearly, “too few” patients with cardiogenic shock have IABP support, and perhaps “too many” are used to support “high-risk” angiography and angioplasty where the indications are less clear.

**REFERENCES**