

Preoperative Optimization of Multi-Organ Failure Following Acute Myocardial Infarction and Ischemic Mitral Regurgitation by Placement of a Transthoracic Intra-Aortic Balloon Pump

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ABSTRACT

Background: The management of acute myocardial infarction with resultant acute ischemic mitral regurgitation and acute multi-organ failure can prove to be a very challenging scenario. The presence of concomitant vascular disease can only serve to further compromise the complexity of the situation. We demonstrate a new indication for the transthoracic intra-aortic balloon pump as a *preoperative* means of unloading the heart and improving clinical outcome in such high-risk patients with severe vascular disease.

Methods: We present the case of a 75-year-old man with a history of severe vascular disease who was transferred emergently to Vanderbilt University Medical Center with an acute inferolateral wall myocardial infarction resulting in severe acute ischemic mitral regurgitation and acute multi-organ failure. He presented with shock liver (serum glutamic-oxaloacetic transaminase [SGOT] of 958), renal failure (creatinine of 3.0), and respiratory failure with a pH of 7.18. Emergent cardiac catheterization revealed 100% occlusion of the left circumflex artery as well as severe iliofemoral disease. The advanced nature of his iliofemoral disease was such that the arterial access catheter occluded the right femoral artery. The duration of time that the catheter was in the artery led to transient limb ischemia with an elevation of his creatine phosphokinase (CPK) to 10,809. Balloon angioplasty followed by stent placement was successfully performed, which restored flow to the coronary vessel. Given the grave nature of the patient's condition, we were very concerned that immediate operative intervention for his condition would entail prohibitively high risk. In fact, the Society of Thoracic Surgeons predicted risk adjusted mortality was calculated to be 56%. In order to minimize patient mortality and morbidity, it was critical to help restore perfusion and organ recovery. Therefore, we decided that the chances for this patient's survival would improve if his condition could be optimized by placement of an intra-aortic balloon pump before undergoing surgery.

Given the limb ischemia following arterial sheath insertion, femoral placement of an intra-aortic balloon pump was not an option. Placement of the intra-aortic balloon pump was attempted via a left subclavian artery cutdown, but was not successful. Therefore, a sternotomy was performed, and we placed a transthoracic intra-aortic balloon pump in order to stabilize the patient's hemodynamics and allow for organ recovery.

Results: The patient showed immediate improvement, and 4 days later, the multi-organ failure resolved and he successfully underwent mitral valve replacement. The patient was ultimately discharged to a local rehabilitation facility in satisfactory condition.

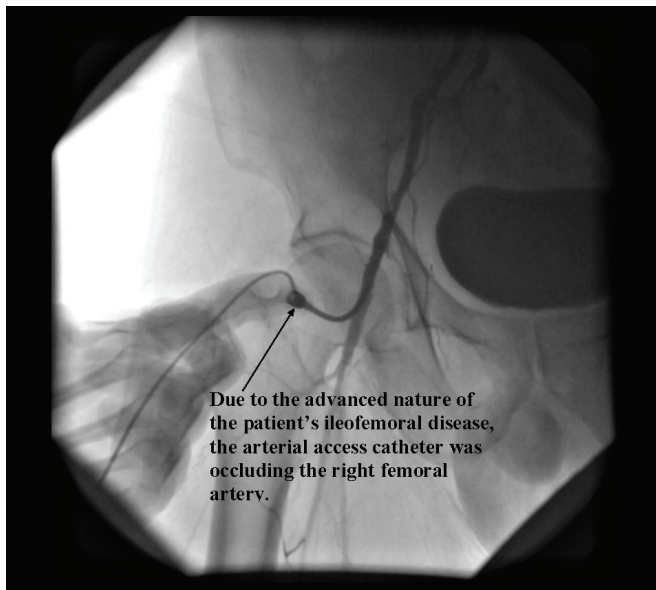
Conclusion: This case demonstrates the utility of a transthoracic intra-aortic balloon pump as a *preoperative* means of stabilization in very high risk patients with severe peripheral vascular disease in whom the conventional approaches are not possible.

INTRODUCTION

Surgical intervention for acute myocardial infarction with associated acute ischemic mitral regurgitation and acute multi-organ failure is a very high risk procedure that has been well established in the literature [Miller 2001]. The cardiac surgeon is faced with the challenge of not only correcting the pathology of mitral regurgitation, but also minimizing the risks involved and optimizing the clinical outcome and quality of life. The central principle in lowering the mortality and morbidity of a cardiac operation in a patient with multi-organ failure due to shock is to allow recovery of the organs while perfusion to tissues is maintained. The intra-aortic balloon pump has proved to be a useful device for reducing afterload and therefore myocardial oxygen consumption, as well as increasing coronary perfusion [Christenson 2001]. Transthoracic placement of the intra-aortic balloon pump has been well described [Hazelrigg 1992]. Placement is typically performed at the conclusion of the operation prior to weaning from cardiopulmonary bypass machine. We propose a new indication for the transthoracic intra-aortic balloon pump as a *preoperative* means of unloading the heart and optimizing clinical outcome in very high risk patients with severe peripheral vascular disease, in whom the conventional approaches may not be possible.

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Due to advanced iliofemoral disease, the arterial access catheter caused occlusion of the right femoral artery.

CASE REPORT

A 75-year-old Cambodian man with a history of peripheral vascular disease and myocardial infarction in 1997 presented with an acute inferolateral wall myocardial infarction and was taken emergently to the cardiac catheterization lab. Coronary angiography revealed a 100% occlusion of the left circumflex coronary artery, which was successfully stented. Angiography of the iliofemoral arteries was performed and revealed severe vascular disease. It was also noted that the arterial access catheter was occluding the right femoral artery (Figure), causing transient limb ischemia and elevation of his creatine phosphokinase (CPK) to 10,809. The patient developed flash pulmonary edema on the table requiring emergent intubation. Transesophageal echocardiogram revealed severe mitral regurgitation with an ejection fraction of 35%, an akinetic inferior wall, and significant left ventricular hypertrophy. He was transferred to the intensive care unit, and within the course of the next few hours the patient developed oliguric renal failure (creatinine of 3.0), shock liver (serum glutamic-oxaloacetic transaminase [SGOT] of 958), and ongoing respiratory failure (acidosis with a pH of 7.18). The Cardiac Surgery Department was consulted to discuss surgical options for his severe acute ischemic mitral regurgitation.

Upon careful review of his case, the Society of Thoracic Surgeons predicted risk adjusted mortality for this patient was calculated to be 56% if he were to undergo immediate mitral valve replacement in the setting of multi-organ failure. It was decided that the patient's best chance of survival was to place an intra-aortic balloon pump to stabilize the patient's condition, optimize perfusion, and allow for functional recovery of the organs. We realized, however, that the conventional peripheral route of intra-aortic balloon pump

insertion was not possible given the severity of his vascular disease. Attempts were made to place an intra-aortic balloon pump under fluoroscopic guidance utilizing a left subclavian artery cutdown. The patient was prepped and draped, and a cut down onto the left subclavian artery was performed; however, we were unable to successfully pass the guidewire into the descending aorta despite multiple attempts.

Therefore, we decided to place the intra-aortic balloon pump in the ascending aorta. A median sternotomy was performed and pledgeted purse string cannulation sutures were placed in the ascending aorta. Using the Seldinger technique with transesophageal echocardiographic guidance, the transthoracic intra-aortic balloon pump was guided into the descending aorta and the cannulation sutures were snared into place. The proximal portion of the intra-aortic balloon was then tunneled under the sternum and the chest was closed in the standard fashion. There was sufficient diastolic augmentation once the intra-aortic balloon was initiated.

Postoperatively, the patient returned to the intensive care unit in stable condition and was carefully monitored. Over the next 4 days, he showed continued improvement. Laboratory tests demonstrated his renal function, liver function, and cardiac enzymes to have normalized. Given the degree of improvement noted in his condition since his admission 4 days prior, we were confident that the patient had been sufficiently stabilized to surgically correct his mitral regurgitation. The patient was returned to the operating room for mitral valve replacement. His sternum was reopened, the intra-aortic balloon was removed, and cardiopulmonary bypass was instituted. Utilizing a left atrial approach via the intra-atrial groove, the mitral valve was exposed, and a ruptured papillary muscle was identified. A mitral valve replacement was performed with a 25 mm pericardial tissue valve, and the patient tolerated the procedure satisfactorily. The patient was weaned from cardiopulmonary bypass, the chest was left open and the patient was transported to the intensive care unit. Two days after his mitral valve replacement, the mediastinum was closed, and the patient tolerated the procedure well. The patient required tracheostomy and gastric feeding tube placement during his post-operative hospital stay, but was ultimately discharged to a local rehabilitation facility in stable condition approximately 6 weeks after his admission without requiring any ventilator support. Given the patient's very poor prognosis at the time of presentation, we were pleased with the overall clinical outcome.

DISCUSSION

The transthoracic intra-aortic balloon pump has been well established as a safe and effective method to wean patients from cardiopulmonary bypass when left ventricular function is compromised. However, we proposed a new use for this modality in the preoperative setting when peripheral vascular disease precluded conventional placement and the patient's condition was too critical to tolerate cardiopulmonary bypass and required urgent stabilization prior to surgery. Using the Online Society of Thoracic Surgeons Risk

Calculator, our patient had a predicted in-hospital mortality rate of 56% if he had undergone immediate surgery to correct his mitral regurgitation. The patient was satisfactorily stabilized, tolerated his procedure well, and was discharged to a rehabilitation facility in stable condition. This case demonstrates the important utility that a transthoracic intra-aortic balloon pump can have in stabilizing high-risk, critically ill patients with severe vascular disease prior to undergoing surgical intervention.

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