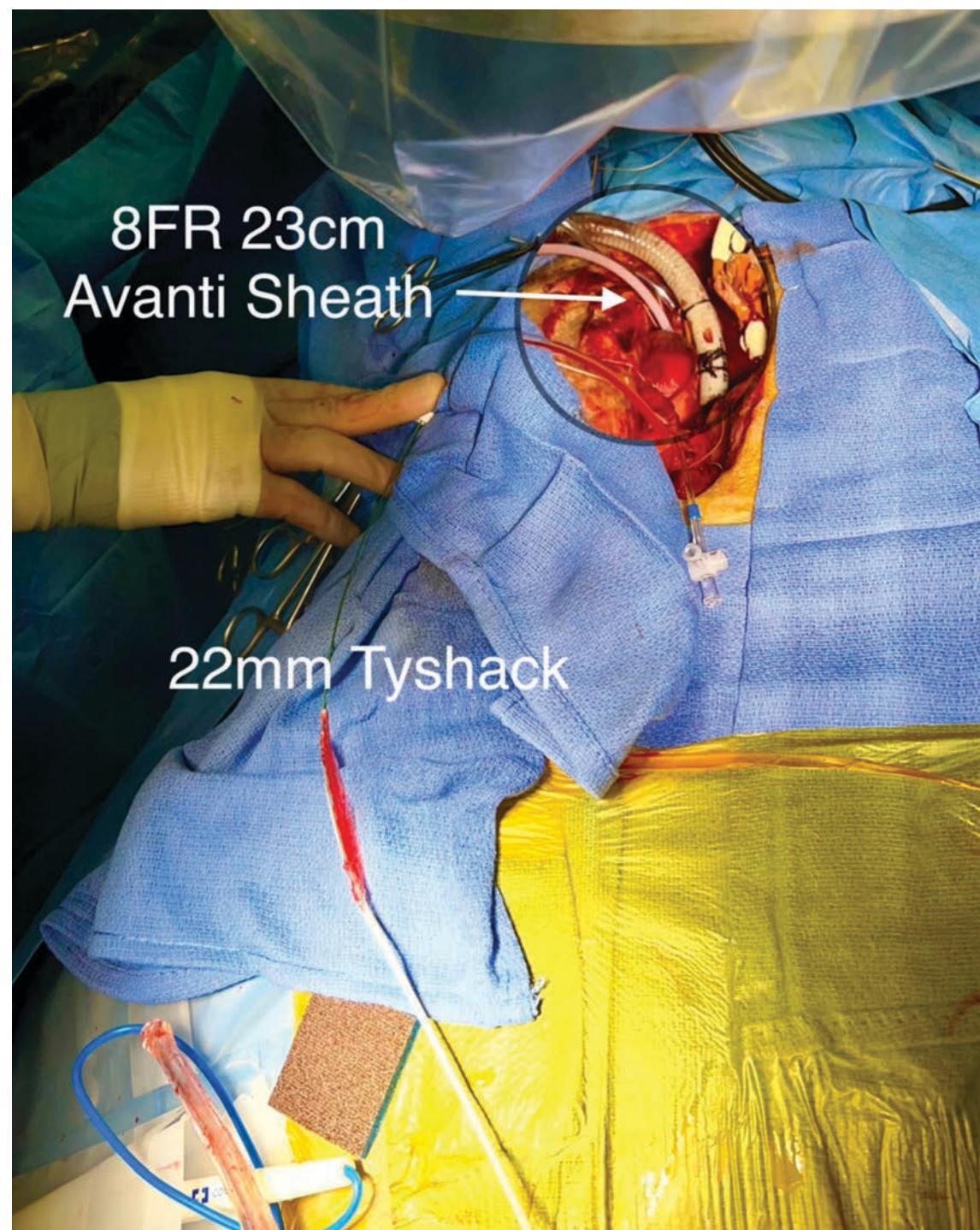


# Successful Treatment of Early Bioprosthetic Mitral Valve Fusion in a Patient on VA ECMO With Balloon Valvuloplasty via Direct Cannulation of Pulmonary Vein

Richard Casazza, MAS, RT(R)(CI); Paul Saunders, MD; Bilal Malik, MD; Robert Frankel, MD; Mazin Khalid, MD; Adnan Sadiq, MD; Arsalan Hashmi, MD; Gregory Crooke, MD



**Figure 1.** Direct cannulation of the right superior pulmonary vein an 8-French 23-cm Avanti+ sheath introducer (Cordis) into the left atrium.

## Abstract

We present a case of a 57-year-old male who underwent bioprosthetic mitral valve replacement (MVR) and developed postoperative cardiogenic shock requiring venoarterial extracorporeal membrane oxygenation (VA ECMO) and Impella 5.5 hemodynamic support. After 14 days on VA ECMO, echocardiography revealed complete fusion of the bioprosthetic mitral valve leaflets. The patient was successfully treated with balloon valvuloplasty with direct access through the right superior pulmonary vein, resulting in improvement in valve function and avoidance of repeat surgery. This case demonstrates the feasibility and efficacy of balloon valvuloplasty as a treatment option for early bioprosthetic valve dysfunction in high-risk patients.

Bioprosthetic mitral valve replacement is a common surgical procedure for patients with mitral valve disease. However, bioprosthetic valves are associated with the risk of early valve dysfunction, which can lead to significant morbidity and mortality.<sup>1</sup> Cardiogenic shock is a serious complication that can occur after cardiac surgery and requires urgent intervention, including venoarterial extracorporeal (VA ECMO) support. The effect of VA ECMO on bioprosthetic valve function is not well understood, and there is limited data on the optimal management of early valve dysfunction in this population. Several cases have been reported of bioprosthetic mitral valve stenosis during VA ECMO life support successfully treated using percutaneous balloon valvuloplasty.<sup>2</sup> However, there are no cases in the literature demonstrating direct pulmonary vein cannulation with an open chest.

## Case

**History.** A 59-year-old male of Southeast Asian descent presented to the emergency department complaining of worsening dyspnea on exertion and orthopnea for 3 days prior to admission. He had a past medical history of coronary artery disease with prior angioplasty to the left anterior descending artery (LAD) and the left circumflex artery (LCX), diabetes mellitus, dyslipidemia, heart failure with reduced ejection fraction of 35%, and chronic kidney disease. His systemic review was unremarkable. The patient had been on furosemide, which was stopped 3 weeks prior to admission by his nephrologist due to worsening renal function. His vital signs were within normal limits. Initial laboratory investigations were remarkable for an elevated cardiac troponin I of 0.46 (normal value 0.00 – 0.04 ng/mL), a beta natriuretic peptide of 3449 (normal value <100 pg/mL). His blood chemistry showed some electrolyte abnormalities with a creatinine of 3.1 (normal value 0.05 – 1.3 mg/dL). A chest x-ray revealed bilateral interstitial infiltrates and edema with small right pleural effusion. The patient was started on intravenous diuresis and admitted to the cardiology unit for further management. Over the

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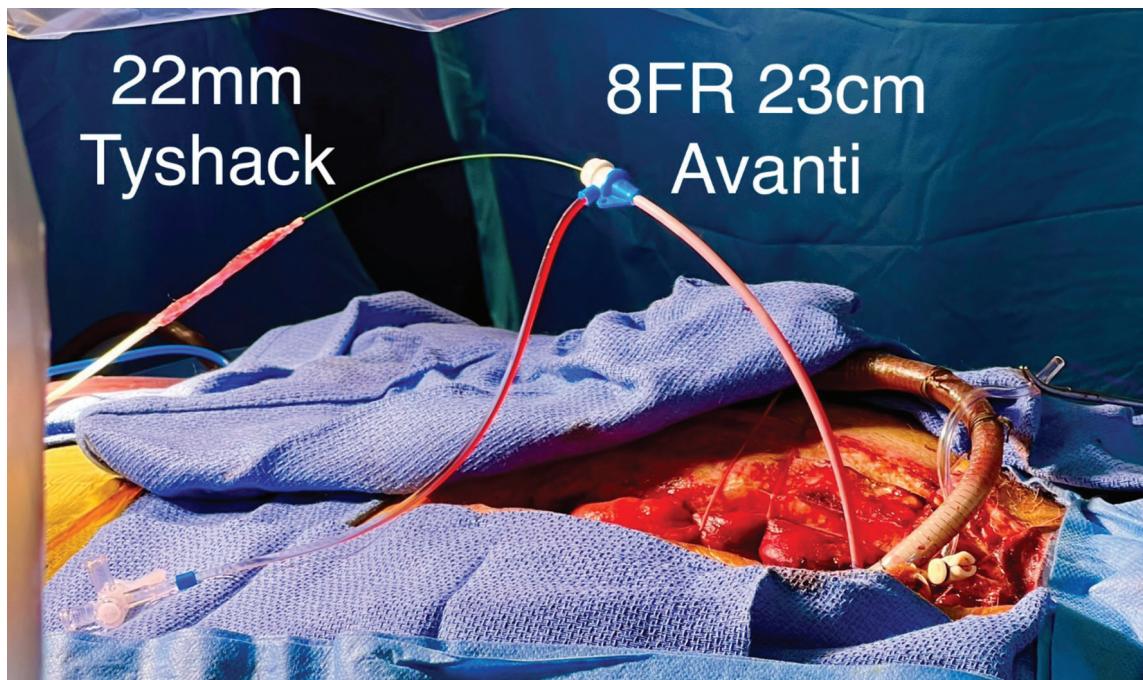


Figure 2. A 22 mm x 5 mm Tyshak II balloon (B. Braun) across the mitral valve.

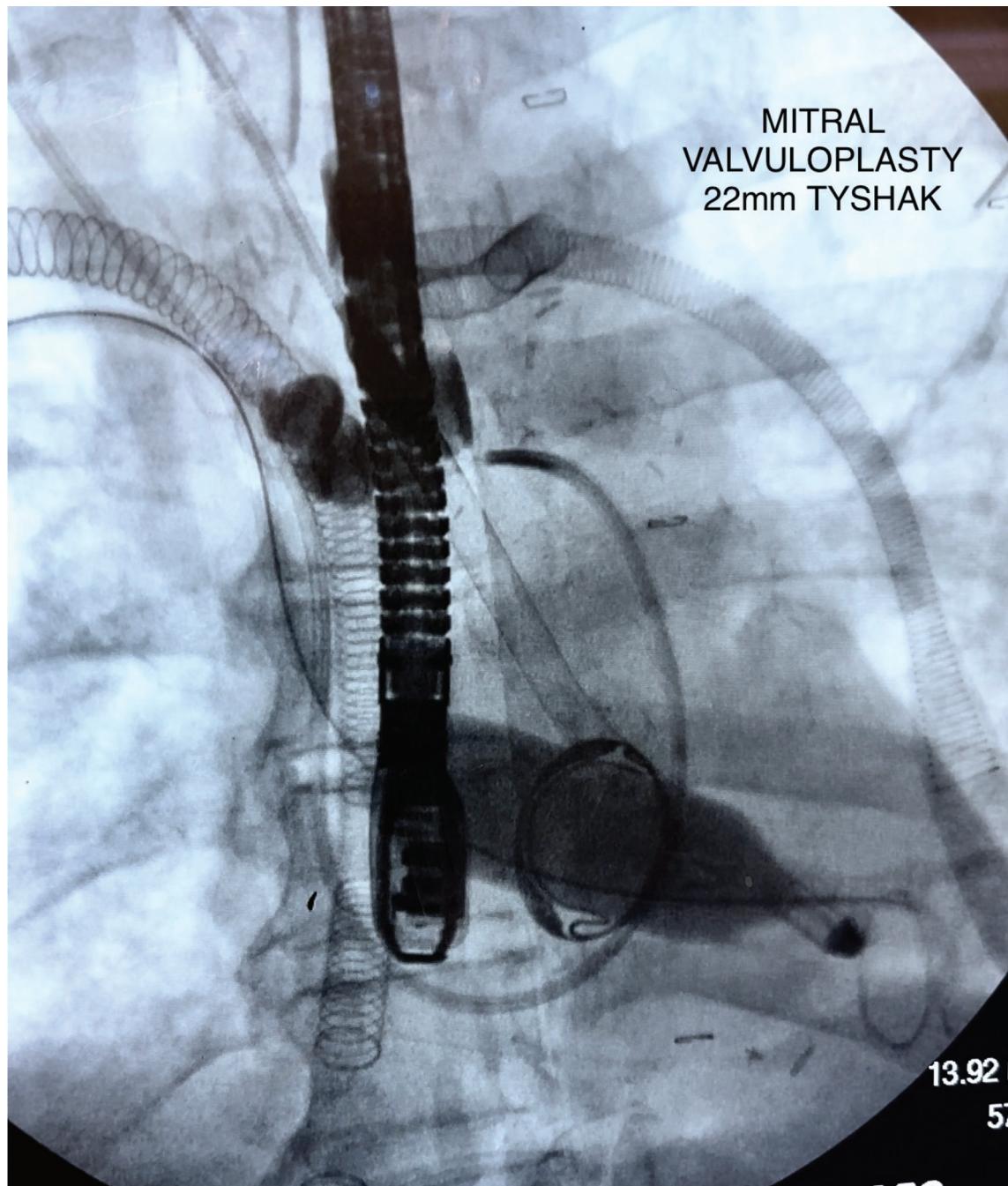


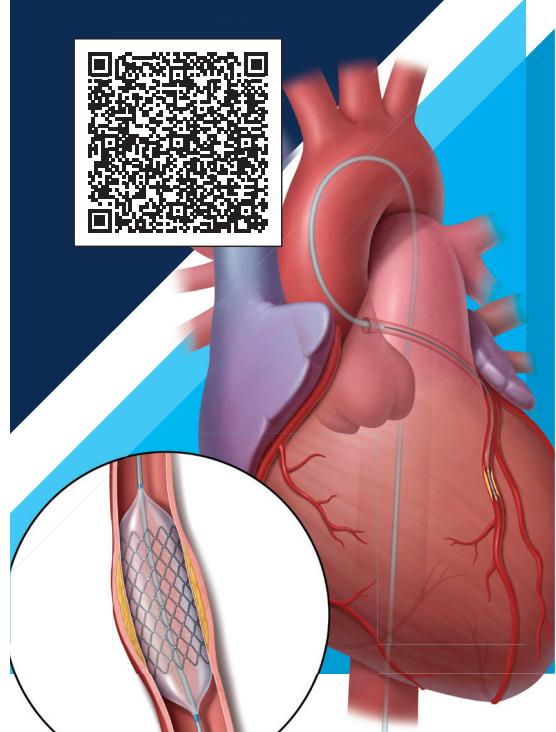
Figure 3. Fluoroscopic image of Tyshak II balloon (B. Braun) dilating the mitral valve.

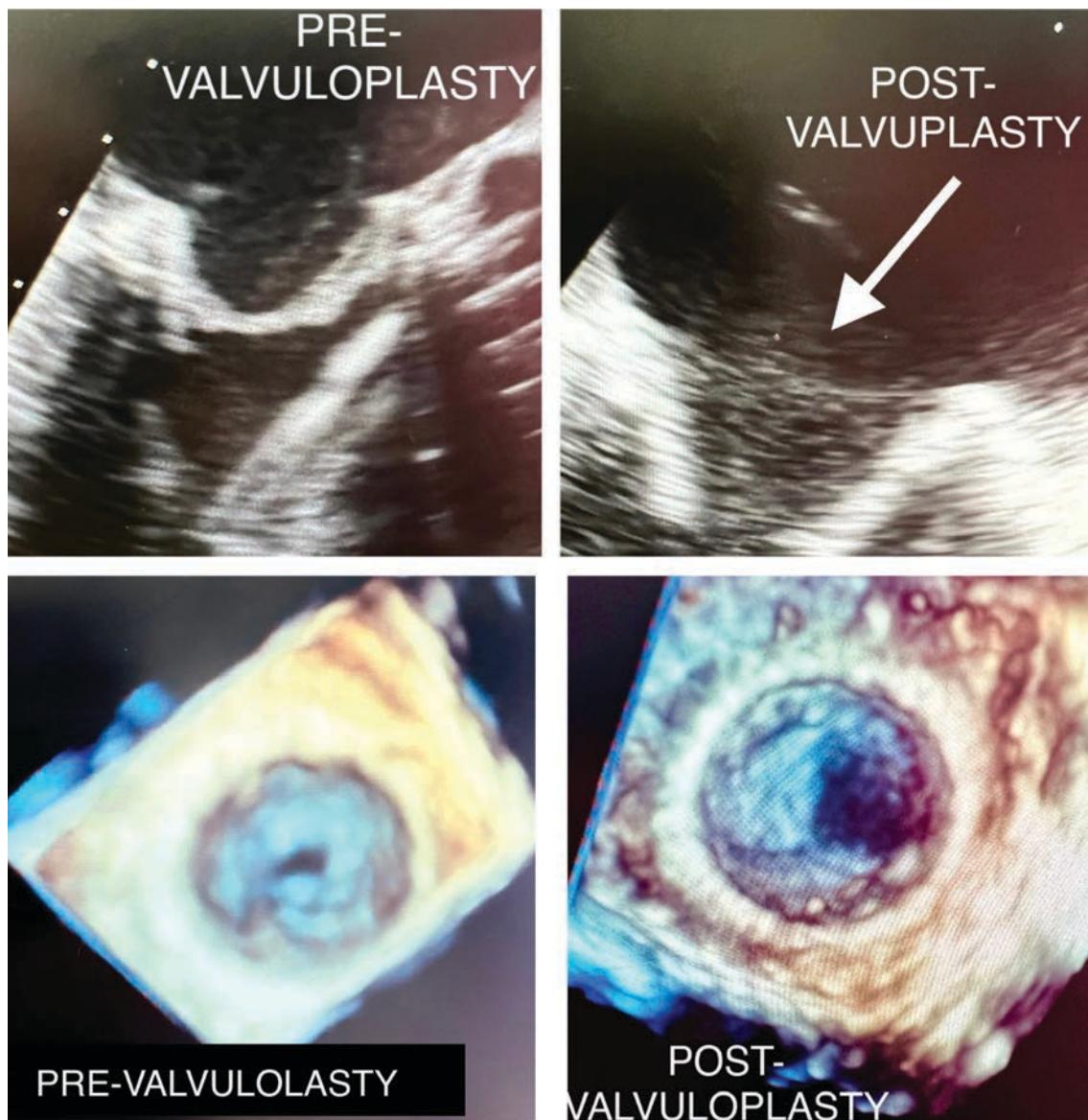
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**Figure 4.** Pre- and post- intraoperative echocardiogram of the mitral valve.

course of the next 12 days, the patient was started on hemodialysis with improvement of his laboratory values and fluid overload, with marked improvement in symptoms. He was managed for non-ST elevation myocardial infarction with intravenous heparin and goal-directed medical therapy. His troponin peaked at 4.0 ng/mL. The patient underwent an elective angiogram that showed a left-dominant system with severe left main disease and severe in-stent restenosis in both the LAD and LCX. He underwent coronary artery bypass grafting with a left internal mammary artery graft into the LAD and three venous grafts into the diagonal artery, left posterolateral artery, and ramus intermedius artery. He also underwent mitral valve replacement with a 29 millimeter (mm) bioprosthetic mitral valve due to moderate to severe mitral regurgitation noted on echocardiography. Post operatively, he was managed in the cardiothoracic intensive care unit with direct VA ECMO and a percutaneous left ventricular assist device (Impella 5.5 [Abiomed]) due to cardiogenic shock. The patient's chest was left open due to hemodynamic instability and coagulopathy.

**Procedure.** After 14 days on VA ECMO and Impella 5.5, echocardiography revealed complete

fusion of the bioprosthetic mitral valve leaflets, resulting in severe mitral stenosis (mean gradient of 14 mmHg) and an 0.3 cm<sup>2</sup> valve area. The patient was deemed high risk for repeat surgery due to comorbidities and a minimally invasive approach was pursued. Mitral valvuloplasty was deemed the appropriate intervention. Via direct cannulation of the right superior pulmonary vein, an 8 French 23 cm Avanti+ (Cordis) was advanced into the left atrium (Figures 1-2). A Confida wire (Medtronic) was then advanced into the left ventricle. A 22 mm x 5 mm Tyshak II balloon (B. Braun) was placed across the mitral valve (Figure 3) and adequately inflated, resulting in immediate improvement in valve function (mean gradient 3 mmHg) and a valve area of 1.5 cm<sup>2</sup>. The pulmonary vein was closed with a 4-0 Prolene purse-string suture. Intraoperative echocardiography demonstrated significant leaflet motion improvement (Figure 4). Subsequently, the patient's hemodynamics improved and ECMO was removed. The Impella was removed nine days later. Two weeks later, the patient developed sepsis that was treated with multiple antibiotics and he unfortunately expired.

## Discussion

Balloon valvuloplasty is a minimally invasive treatment option for bioprosthetic valve dysfunction that has been shown to be effective in selected patients. Our technique involves the placement of a balloon catheter through the right superior pulmonary vein and inflation within the stenotic valve to break up adhesions and improve valve function. This approach is particularly attractive in high-risk patients who are deemed unsuitable for repeat open-heart surgery due to comorbidities or advanced age. In this case, the patient was successfully treated with balloon valvuloplasty, avoiding the need for repeat surgery and the associated risks of morbidity and mortality.

## Conclusion

This case highlights the feasibility and efficacy of balloon valvuloplasty as a bailout option for early bioprosthetic valve dysfunction in high-risk patients. The technique can be performed directly through the pulmonary vein, avoiding the need for open-heart surgery and minimizing the risk of further complications. More research is needed to identify optimal patient selection criteria and to better understand the long-term outcomes of balloon valvuloplasty for bioprosthetic valve dysfunction. To the best of our knowledge, our report is the first known case of direct pulmonary vein cannulation for mitral valvuloplasty post mitral valve replacement. ■

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**Richard Casazza, MAS, RT(R)(CI);  
Paul Saunders, MD; Bilal Malik, MD;  
Robert Frankel, MD; Mazin Khalid, MD;  
Adnan Sadiq, MD; Arsalan Hashmi, MD;  
Gregory Crooke, MD**

Maimonides Medical Center, Brooklyn, New York

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The authors can be contacted via Richard Casazza, MAS, RT(R)(CI), at all4ugq@aol.com.