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Case Report

Hemopericardium After TAVR: Assessment

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TRANSCATHETER AORTIC valve replacement (TAVR) is offered to intermediate- to high-risk patients with aortic valve pathology and dysfunction, most commonly for aortic valve stenosis.[1–8] Short- and long-term outcomes are superior to medical therapy and at least equivalent to surgical aortic valve replacement.[1–4] The targeted population initially were patients considered to be the highest risk and inoperable. These patients were elderly and frail and/or possessed significant surgical risk factors (calcified aorta and/or aortic annulus, prior sternotomy, or radiation) that prohibited conventional surgical aortic valve replacement.

The TAVR procedure may be performed from the transfemoral artery or transsubclavian artery or via the proximal ascending aorta. Alternatively, a transapical approach through the left ventricular apex can be used. An aortic valve balloon valvuloplasty is performed, followed by placement and balloon inflation/expansion of a bioprosthetic valve, with these 2 procedures being performed during rapid ventricular pacing–induced hypotension. Depending on the amount of aortic insufficiency, the stability of the valve, and the transvalvular gradient, a second and perhaps a third balloon inflation may be desired to expand the new valve maximally.

Complications include myocardial infarction, heart failure, arrhythmias, heart block/conduction delays, stroke, major bleeding, hemopericardium, valve embolization, aortic regurgitation, disruption of the mitral apparatus and mitral regurgitation, aortic dissection, aortic rupture, and death.[8–11] Echocardiographic imaging allows a rapid evaluation of the new valve and these potential complications.[12,13]

Depending on the risk assessment, patients may be scheduled for the procedure with the understanding that there is no planned cardiopulmonary bypass or surgical backup if things go awry. Herein the authors present a case of hypotension after TAVR in an elderly, frail patient and describe the assessment and management of hemopericardium.

Case Report

The patient was a 90-year-old female who was considered to be inoperable for conventional aortic valve replacement and who presented for TAVR via the femoral artery, with intravenous sedation as the anesthetic modality. Before the procedure, cardiac imaging revealed critical aortic stenosis, a calcified aortic root, and normal biventricular function. Doppler examination demonstrated an estimated pulmonary artery pressure of 45 mmHg, an AVA of 0.5 cm^2, and peak and mean transaortic valve gradients of 100 and 56 mmHg, respectively.

After placement of a catheter in the right radial artery and 2 intravenous catheters, the patient was taken to the operating room. With the patient under moderate sedation, the procedure was performed using the right and left femoral arteries. A balloon valvuloplasty was performed using a 20-cm diameter and 4-cm long balloon catheter during rapid ventricular pacing, followed by deployment of a 23 mm Sapien 3 (Edwards Lifesciences, Irvine, CA) transcatheter heart valve into the aortic valve position. During the procedure, there was minimal hemodynamic support (2 µg/min intravenous norepinephrine).

A transthoracic echocardiogram showed the valve to be well-seated with trace aortic valve insufficiency. Peak and mean gradients were 31 and 15 mmHg, respectively. After removal of the procedural catheter and ventricular pacing wire, a pericardial effusion, 25 mm in width with right atrial

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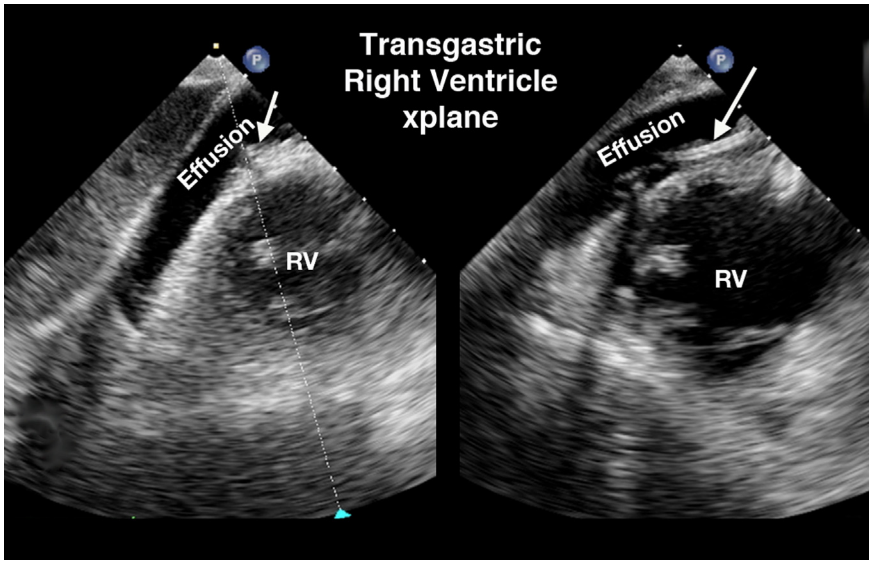

Fig 1. Transgastric x-plane view of the right ventricle. The right ventricle is seen in both a short axis *(left)* and a long axis *(right)* surrounded by the pericardial effusion. The *white arrow* points to a silastic drain, which is 0.8 cm in diameter. RV, right ventricle.

collapse, was noted (Fig 1, Video 1). A pericardiocentesis was performed using an 18-gauge thin-walled needle and confirmed using fluoroscopy and a small amount of contrast injected into the pericardial space. A J-wire was passed into the pericardial space, and a multi-holed catheter was advanced over the wire into the pericardial space. Over the next 10 minutes, a total of 600 mL of bloody fluid was removed and autotransfused. As drainage continued the patient was resuscitated with intravenous fluids and an increasing dose of intravenous norepinephrine (up to 5 µg/min). Systemic hemodynamics were maintained. A blood gas analysis of the mediastinal fluid was obtained (Table 1).

Consideration of a median sternotomy led to the administration of general anesthesia with endotracheal intubation and placement of a central venous introducer. Transesophageal echocardiography (TEE) was performed and showed normal biventricular and valve function. The pericardial effusion (see Fig 1; Video 2) and a suspicious high-velocity flow within the pericardial space overlying the right ventricular (RV) free wall were demonstrated, which prompted concern that an RV injury resulted from the ventricular pacing wire (Fig 2, Video 3). Focus was placed on this as the site of injury.

In the presence of continued drainage of pericardial fluid (Video 4), a median sternotomy was performed and the mediastinum was explored. A large amount of blood and clot was removed. A small area along the RV apex appeared to be

Table 1
Simultaneous blood gas analysis from the arterial cannula and the pericardial fluid

	pH	pCO2	pO2
Pericardial Effusion	7.40	40	100
Arterial Sample	7.44	35	130

Abbreviations: pH, measure of acidity; hydrogen ion concentration: pCO2, partial pressure of carbon dioxide: pO2, partial pressure of oxygen

injured and was sutured. Because bleeding had stopped and hemodynamics improved, there was no further inspection. The aortic root was not manipulated. A 24 Fr (0.8 cm) silastic mediastinal drain was placed, and after 30 minutes of observation, the sternum was closed (Video 5).

After chest closure, bleeding was noted from the mediastinal drains, despite a normal activated clotting time. The patient required an increasing dose of norepinephrine and continued fluid administration. Re-examination with TEE revealed an organized pericardial effusion (Video 6). In light of the prior blood gas analysis of the pericardial fluid and after a brief but comprehensive TEE examination, focus was directed toward the left heart, the prosthetic aortic valve, the aortic root, and the ascending aorta. A thickening of the para-aortic area surrounding the prosthetic valve, consistent with a para-aortic hematoma, was noted (Fig 3, Videos 7 and 8).

Blood continued to drain from the mediastinal tubes. In the context of the results of the blood gas analysis, the abnormal para-aortic findings during the TEE examination, a recurring pericardial effusion, and continued need for fluids and vasopressor support to sustain hemodynamic stability, the sternum was reopened by a second surgeon.

A large amount of blood and clot was removed. There was no bleeding noted from the right heart. After inspection, an injury was noted involving the proximal posterior aortic wall along the aortoventricular groove extending to the sinotubular junction. Bleeding from this site was controlled with packing and then was repaired with Surgicel (Ethicon, Somerville, NJ) and BioGlue (CryoLife, Kennesaw, GA). The area appeared hemostatic, and the sternum was left open. The patient returned to the operating room the next day for sternal closure. During this time, TEE examination showed that the aortic wall thickening appeared to have decreased (Fig 4).

The patient had an uneventful recovery and ultimately was discharged home after a brief stay in a skilled nursing facility.