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CASE REPORT: CLINICAL CASE

# Percutaneous Management of a Contained Annular Rupture Occurring With Self-Expanding Transcatheter Aortic Valve Replacement

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## ABSTRACT

Annular rupture is a rare catastrophic event during transcatheter aortic valve replacement, often life threatening and requiring emergent surgical repair. We describe, herein, a case of contained annular rupture successfully managed percutaneously with coiling and polymer injection. This is a novel technique to manage this complication. **(Level of Difficulty: Advanced.)** (J Am Coll Cardiol Case Rep 2020;2:1852–8) © 2020 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

## HISTORY OF PRESENTATION

We describe a 70-year-old man who presented with gastrointestinal bleeding and was found to have evidence of heart failure and severe aortic stenosis (peak/mean gradients: 125/80 mm Hg, respectively). Coronary angiography was without significant obstruction. Four-dimensional ECG-gated cardiac computed tomography (CT) angiography (**Figure 1**) showed a moderately calcified aortic annulus (mean diameter area-derived: 22.7 mm, perimeter-derived: 22.3 mm), a Bicuspid Seivers-1 aortic valve, and no left ventricular outflow tract (LVOT) calcium. Low-risk isolated surgical aortic valve replacement was recommended; however, the patient indicated a strong preference for transcatheter aortic valve replacement (TAVR).

### LEARNING OBJECTIVES

- To review a case of contained annular rupture occurring during post dilation after self-expanding TAVR implantation.
- To recognize the imaging findings of annular rupture.
- To understand the role of surgical and nonsurgical management of annular rupture.

We performed transfemoral TAVR with a 26-mm Evolut Pro+ valve (Medtronic, Minneapolis, Minnesota) after pre-dilation with 20- and 21-mm TRUE valvuloplasty balloons (Bard Peripheral Vascular, Tempe, Arizona). The residual mean gradient was 17 mm Hg—which was felt to be unacceptably high—and post-dilation with a 22-mm TRUE balloon was performed (Video 1). Thereafter, the mean gradient was 10 mm Hg. No pericardial effusion was present; however, a contained area of contrast extravasation was noted on aortography (**Figure 2**, Video 1). The patient remained asymptomatic and hemodynamically stable and was admitted to the cardiac care unit.

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The authors attest they are in compliance with human studies committees and animal welfare regulations of the authors' institutions and Food and Drug Administration guidelines, including patient consent where appropriate. For more information, visit the *JACC: Case Reports* author instructions page.

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## PAST MEDICAL HISTORY

Prior to presentation, there was no prior medical or surgical history.

## DIFFERENTIAL DIAGNOSIS

The differential diagnosis of contrast extravasation from the aorta or LVOT to the extraluminal space is limited and includes contained or uncontained aortic root and LVOT rupture.

## INVESTIGATIONS

On post-operative day (POD) 2, a CT scan showed a 1.1 × 0.8 × 0.7 cm opacified pseudoaneurysm inferior to the right coronary cusp compressing the right coronary artery (**Figure 3**). Serial CT scan on POD 6 remained unchanged, and the patient was discharged. A repeat CT scan performed empirically on POD 23 to assess for stability showed enlargement of the pseudoaneurysm. He remained asymptomatic. Surgical correction was recommended; however, the patient declined unless necessary. We planned for a percutaneous repair with surgical bailout during the same procedure if unsuccessful.

## MANAGEMENT

On POD 45, the patient was placed under general anesthesia in our hybrid operating room. Right coronary artery angiography demonstrated new proximal stenosis from extrinsic compression (**Figure 4**); however, the patient remained without signs of ischemia. We crossed the aortic valve bioprosthesis in a retrograde fashion and exchanged to a Simmons 1 catheter (Cordis Medial, Santa Clara, California), which was manipulated to look up toward the LVOT, but we were unable to lodge the catheter tip outside of the inferior margin of the valve scaffold in a location under the right coronary cusp. Under transesophageal echocardiography and fluoroscopic guidance, the tip of the Simmons catheter was instead placed behind the valve cage at its inferior margin below the left main coronary artery, and a Choice PT Extra Support 0.014-inch coronary guidewire (Boston Scientific, Marlborough, Massachusetts) was advanced outside of the valve frame and used to direct a Prowler Plus 0.021-inch neurovascular microcatheter (Johnson & Johnson, New Brunswick, New Jersey) into the pseudoaneurysm (Video 2).

The Prowler Plus microcatheter delivered two 5 × 20 mm and two 4 × 12 nylon-fibered helical detachable Concerto coils (Medtronic) into the outpouching. We then injected 0.3 ml of Onyx LD ethylene-vinyl alcohol copolymer (Medtronic). At the conclusion, there was no extravasation of contrast into pseudoaneurysm (**Central Illustration**, Video 2). The patient was discharged the following day and remains asymptomatic.

## DISCUSSION

Uncontained annular rupture is estimated to occur in 0.4% of TAVR cases (1-4). Risk factors have been described including subannular LVOT calcification,

**ABBREVIATIONS AND ACRONYMS**

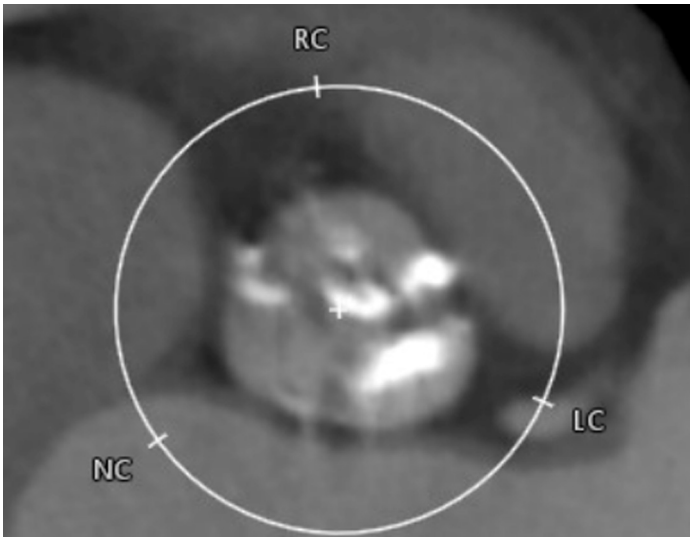
**CT** = computed tomography

**LVOT** = left ventricular outflow tract

**POD** = post-operative day

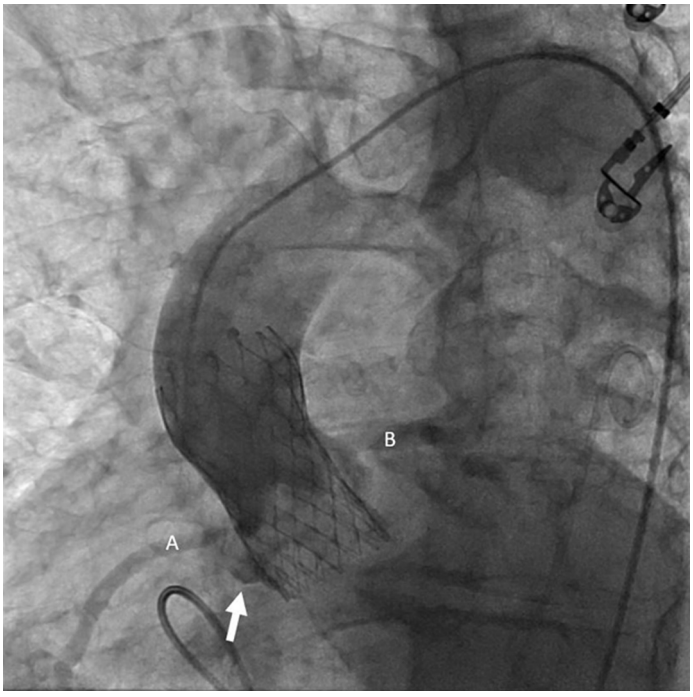
**TAVR** = transcatheter aortic valve replacement

**FIGURE 1 Pre-Procedure Electrocardiogram-Gated Multiplanar Computed Tomography Aortography Demonstrating a Moderately Calcified Bicuspid Aortic Valve**




LC = left coronary cusp; NC = non-coronary cusp; RC = right coronary cusp.

**FIGURE 2 Aortography After Post-Dilation**




Aortography after post dilation demonstrating a well-expanded valve frame with patent right coronary artery **(A)**, left main coronary artery **(B)**, and an area of contrast extending outside of the valve frame consistent with contained annular rupture **(arrow)**.

balloon-expandable valve oversizing, aggressive balloon post-dilation, and bicuspid anatomy, whereas the use of multislice CT has improved rates of TAVR complications including rupture (5,6). Uncontained rupture is managed with emergent surgery; however, there are prior case reports of the use of coil embolization, N-butyl-2-cyanoacrylate-based glue, and an Amplatzer Vascular Plug for management of annular rupture with hemodynamic collapse (7–10).

Contained annular rupture is more common than uncontained rupture, occurring in 1.2% to 4.6% of TAVR cases (11,12) and is associated with more favorable short and long-term outcomes (5,11–14). Notably, all patients in these prior series were implanted with balloon-expandable valves. For contained rupture, a "watchful waiting" approach is recommended (3–5,15).

Percutaneous management of annular rupture with a self-expanding valve presents unique challenges as the valve scaffold is longer, complicating visualization and reaccess. We are aware of 1 other case where a percutaneous strategy was used (9). In that case, the rupture was uncontained and the injury was accessible from the left coronary cusp with an XB-LAD guiding catheter (Cordis, Santa Clara, California) in the standard fashion for coronary reaccess after TAVR.

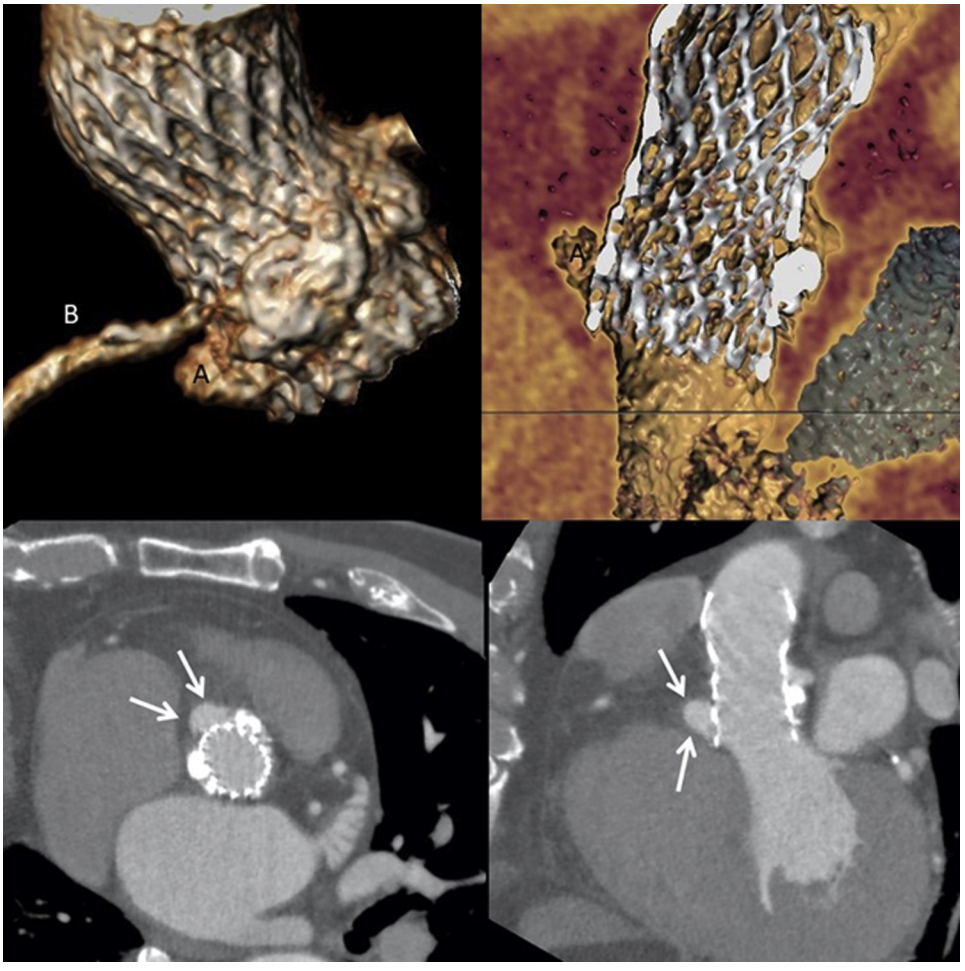
## FOLLOW-UP

Follow-up cardiac CTA at 2 months post-coiling showed obliteration of pseudoaneurysm without extravasation of contrast. The right coronary artery showed no progression of extrinsic compression, and the patient remained free of symptoms of ischemia.

## CONCLUSIONS

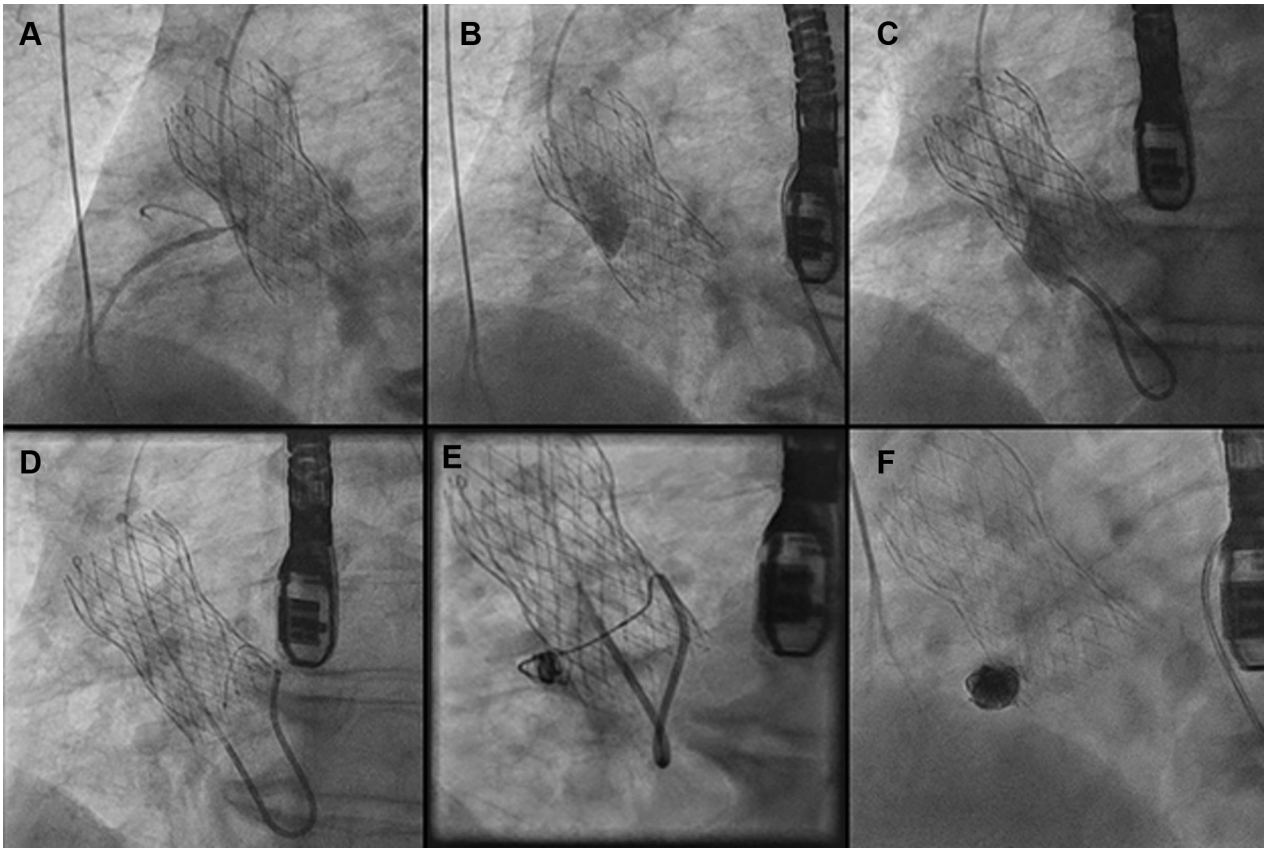
Annular rupture may occur with self-expanding valves, typically during pre- or post-dilation. In this case, we describe a case of annular rupture managed with an endovascular strategy.

**FIGURE 3 Computed Tomography Images of Contained Annular Rupture**



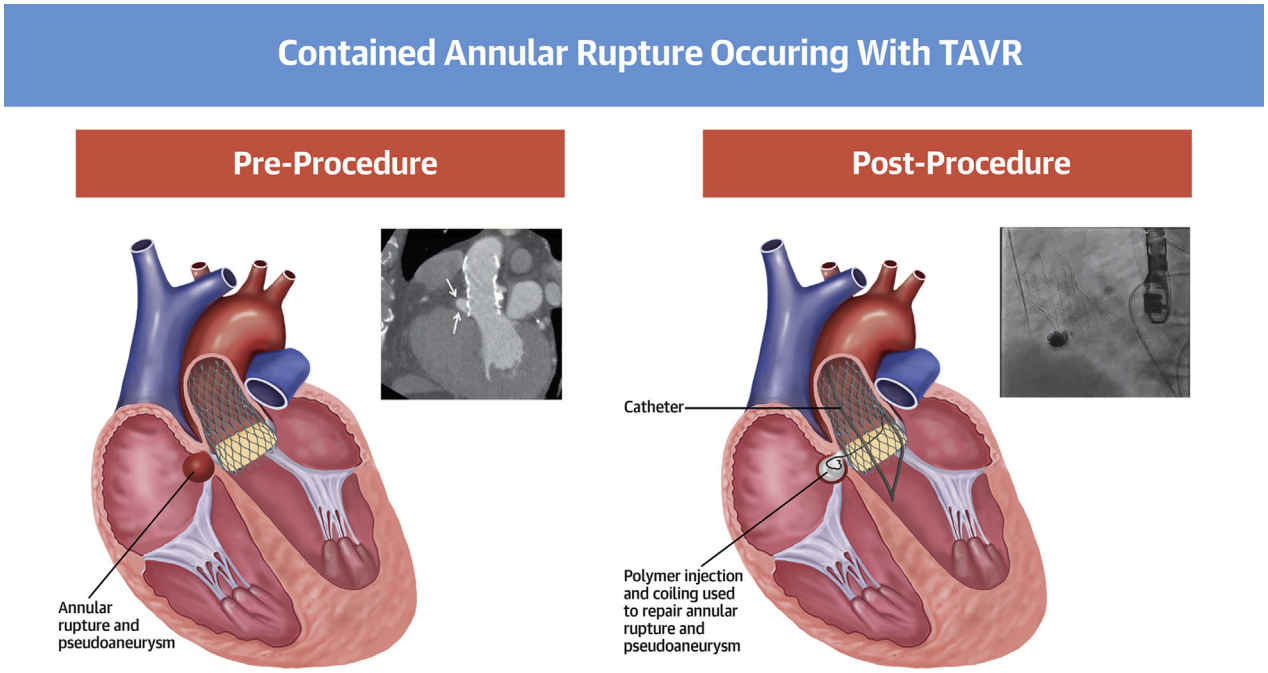

Computed tomography images of aortic valve showing a contained outpouching **(A)** at the inferior aspect of the valve cage below the right coronary artery **(B)**. The **arrows** point to the "contained outpouching."

**FIGURE 4 Fluoroscopic Images of Annular Rupture Repair Procedure**




(A) Right coronary angiography. **(B)** Aortic root angiograph did not demonstrate the outpouching **(C)** Infra-annular ventriculography of the LVOT from within the Evolut Pro + valve frame did not demonstrate the expected outpouching below the right coronary artery secondary to the skirt, which surrounds the valve cage below the neoannulus. **(D)** left anterior oblique projection demonstrating the tip of the Simmons 1 catheter behind the valve frame at a location under the left main coronary artery, the only place it could be stably positioned behind the valve frame. From the catheter, a Prowler Plus microcatheter (Johnson & Johnson, New Brunswick, New Jersey) guided by Choice PT Extra Support coronary guidewire (Boston Scientific, Marlborough, Massachusetts) is advanced anteriorly around the outside of the valve frame and directed toward the expected location of the outpouching. Contrast injections through the microcatheter were able to fill the outpouching. **(E)** The first of 4 nylon-fibered helical Concerto coils (Medtronic, Minneapolis, Minnesota) is delivered to the contained rupture. **(F)** Final result after coiling and injection of Onyx LD ethylene-vinyl alcohol copolymer glue (Medtronic).

**CENTRAL ILLUSTRATION** **Percutaneous Repair of a Contained Annular Rupture**




**Kellogg, M.S. et al. J Am Coll Cardiol Case Rep. 2020;2(12):1852–8.**

Pre-procedure: Diagram and fluoroscopic image demonstrate an outpouching in the aortic root **(arrows)** representing a contained annular rupture. Post-Procedure: Diagram and fluoroscopic image demonstrate successful repair of the contained annular rupture and exclusion from the aorta using coil placement and polymer injection.

## AUTHOR RELATIONSHIP WITH INDUSTRY

Dr. Laham has served as a consultant for Medtronic. All other authors have reported that they have no relationships relevant to the contents of this paper to disclose.

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**KEY WORDS** annular rupture, coiling, Evolut, TAVR

**APPENDIX** For supplemental videos, please see the online version of this paper.