

## Case Report

# The Heart-Team Approach for the Treatment of Radiation-Induced Aortic Stenosis and Coronary Artery Disease: A Case Report

Eve Belzile-Dugas, MD,<sup>a,b</sup> Caroline Michel, MD,<sup>a,b,c</sup> Jean-Francois Morin, MD,<sup>a,d</sup> and Mark J. Eisenberg, MD, MPH<sup>a,b,c,e</sup>

<sup>a</sup> Division of Clinical Epidemiology, Lady Davis Institute, Jewish General Hospital/McGill University, Montreal, Quebec, Canada

<sup>b</sup> Department of Medicine, McGill University, Montreal, Quebec, Canada

<sup>c</sup> Division of Cardiology, Jewish General Hospital/McGill University, Montreal, Quebec, Canada

<sup>d</sup> Division of Cardiac Surgery, Jewish General Hospital/McGill University, Montreal, Quebec, Canada

<sup>e</sup> Department of Epidemiology, Biostatistics and Occupational Health, McGill University, Montreal, Quebec, Canada

### ABSTRACT

We describe the case of a 54-year-old woman admitted to the cardiology ward for the correction of radiation-induced aortic stenosis and coronary artery disease. After careful workup, she underwent surgical aortic valve replacement and aortocoronary bypass with venous grafts. This case demonstrates the late cardiovascular complications that can develop after radiation therapy for cancer, and the surgical complexity of these patients. Thorough workup is needed for the treatment of radiation-induced valvulopathy and coronary artery disease, as these patients are often poor surgical candidates with hostile chests. Multidisciplinary heart-team assessment is paramount, and consideration should be given to catheter-based approaches.

### RÉSUMÉ

Nous décrivons le cas d'une femme de 54 ans admise en cardiologie pour la correction d'une sténose aortique radio-induite et une coronaropathie. Après un bilan minutieux, elle a subi un remplacement valvulaire aortique chirurgical et un pontage aortocoronarien à l'aide de greffons veineux. Ce cas démontre les complications cardiovasculaires tardives qui peuvent survenir après la radiothérapie administrée pour un cancer, et la complexité de l'intervention chirurgicale de ces patients. Un bilan complet est nécessaire avant le traitement de la valvulopathie radio-induite et de la coronaropathie, puisque ces patients sont souvent de mauvais candidats à l'intervention chirurgicale en raison de thorax « hostiles ». Il est primordial que l'équipe multidisciplinaire en cardiologie réalise l'évaluation et il faudrait envisager les approches par cathéter.

### Case

We present the case of a 54-year-old woman diagnosed with Hodgkin's lymphoma at age 18 years, for which she received chemotherapy and radiation of the neck, mediastinum, and abdomen. She was also known to have had surgically resected endometrial and ovarian cancer, hypothyroidism, and diabetes mellitus. She was found on routine follow-up chest computed tomography to have new

bilateral pleural effusions and pulmonary fibrosis, although she was asymptomatic at the time. As part of the workup of pleural effusions, she underwent a cardiac echocardiogram (Fig. 1), which showed a left ventricular ejection fraction of 50%–55%, with moderate diastolic dysfunction and severe calcification of the aortic valve, with resultant severe aortic stenosis (AS; aortic valve area = 0.8 cm<sup>2</sup>). The pericardium was calcified without evidence of constrictive physiology. Electrocardiography did not show any significant conduction-system disease. Given these findings, she was referred to the cardio-oncology clinic. Over the following months, she developed dyspnea, New York Heart Association class II–III, and was admitted to the cardiology ward for workup of possible radiation-induced heart disease.

Cardiac magnetic resonance imaging showed hypokinesis and subendocardial late gadolinium enhancement of the left ventricular inferior wall, affecting less than 50% of myocardial thickness, compatible with ischemia in the area of the right coronary artery. Cardiac catheterization showed

Received for publication April 1, 2021. Accepted June 15, 2021.

**Ethics Statement:** We certify that all authors participated in the work and have reviewed and agreed with the content of this article. Personal identifiers were removed for preserving patient confidentiality.

Corresponding author: Dr Mark J. Eisenberg, Professor of Medicine, Divisions of Cardiology and Clinical Epidemiology, Jewish General Hospital/McGill University, 3755 Côte Ste-Catherine Rd, Suite H-421.1, Montreal, Quebec H3T 1E2, Canada. Tel.: +1-514- 340-8222, x23564; fax: +1-514-340-7564.

E-mail: [mark.eisenberg@mcgill.ca](mailto:mark.eisenberg@mcgill.ca)

See page 1390 for disclosure information.

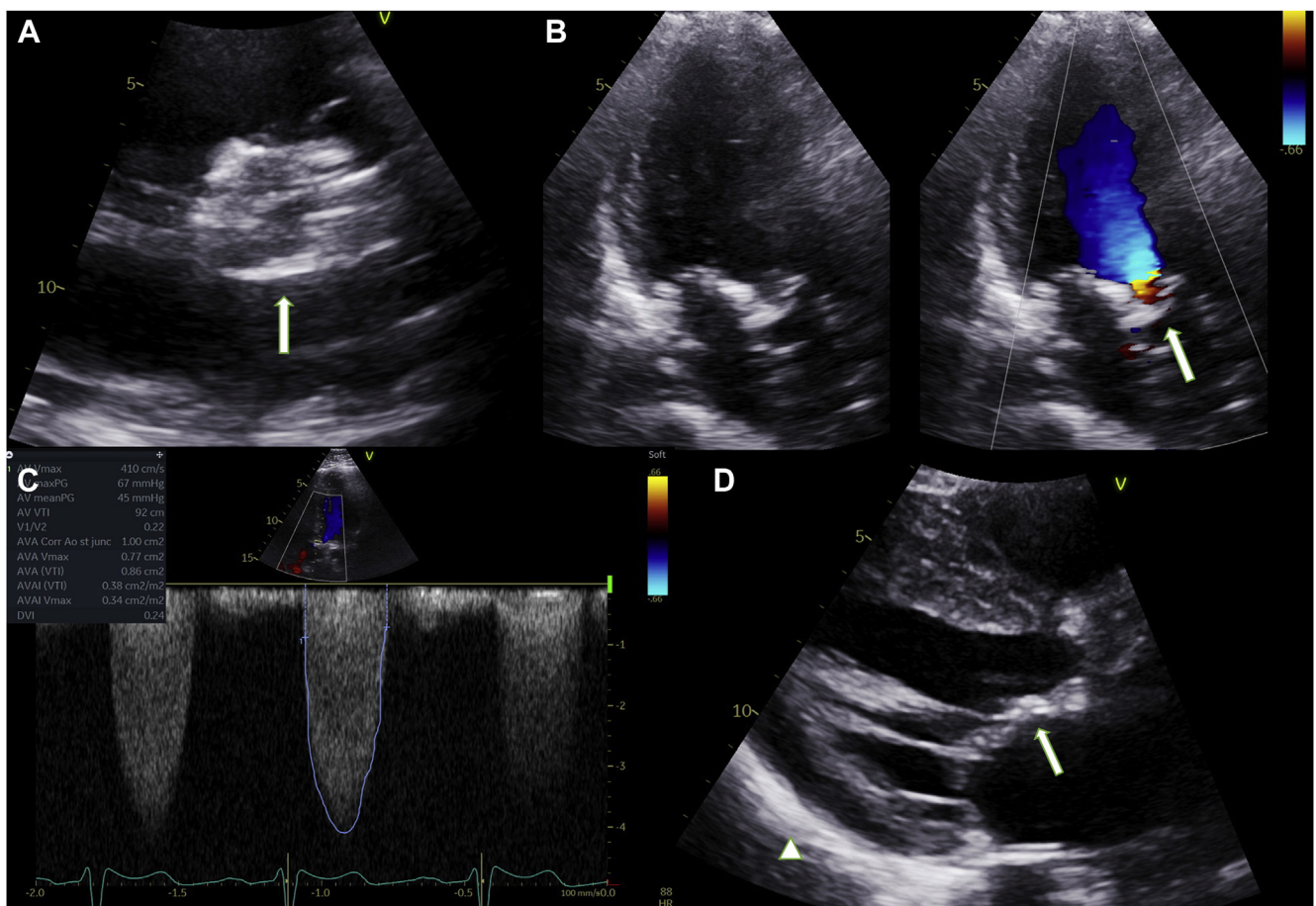
### Novel Teaching Points

- Radiation therapy leads to a wide array of complications of all components of the heart, often decades after completion of treatment.
- Multidisciplinary heart-team assessment is paramount in patients with radiation-induced cardiovascular disease, given their complexity.
- Consideration should be given to catheter-based approaches, as they bypass many potential surgical complications.

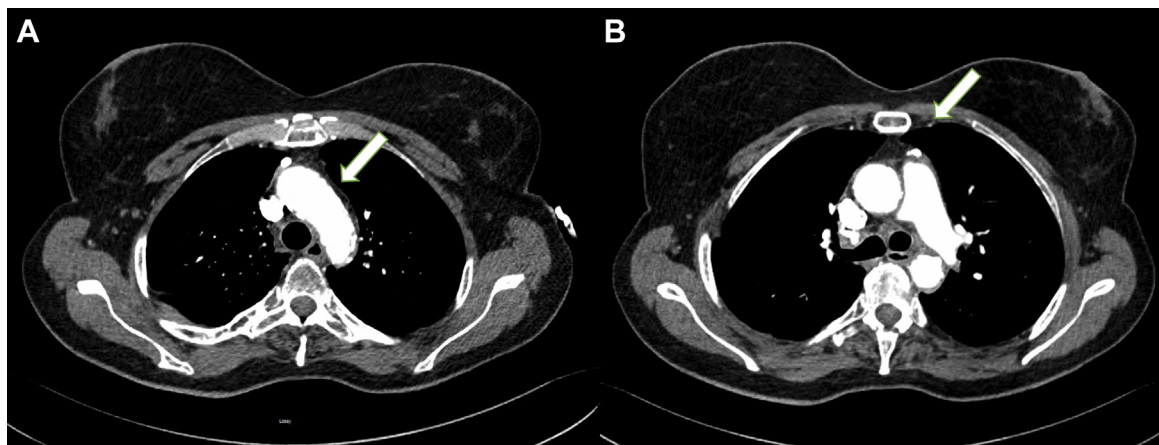
a 50% stenosis of the ostial left main coronary artery, and a chronic total occlusion of the right coronary artery with collaterals from the left-sided circulation, a 70% obtuse marginal lesion, and a 70% diagonal 1 lesion. Distal targets were suitable for surgical revascularization. A computed tomography angiogram of the thorax demonstrated moderate atherosclerosis of the thoracic aorta and minimally calcified

left internal mammary artery, although these were poorly visualized (Fig. 2).

The “heart-team approach” yielded thorough discussions among the cardiac surgeon, the interventional and primary cardiologists, and the patient. These discussions took place both formally at weekly cardiology–cardiac surgery rounds, and informally at bedside with the patient. Surgical and catheter-based approaches were considered for the correction of AS and coronary artery disease. There were concerns that transcatheter aortic valve replacement (TAVR) would cause occlusion of the coronary ostia (because of small coronary sinuses and low-lying coronaries), and that an aorta that was too calcified would render surgical aortic valve replacement (SAVR) difficult. We considered the possibility of proceeding with aortocoronary bypass off-pump, to avoid clamping an excessively calcified aorta, and then TAVR without concern about obstructing the coronaries. Ultimately, given the patient’s young age and the severe AS, the preferred choice remained aortic valve replacement with a mechanical valve. Finally, the choice was made to not proceed with prophylactic partial pericardiectomy, given the absence of constrictive pericarditis on echocardiogram. The patient



**Figure 1.** Echocardiography findings of radiation-induced cardiotoxicity. (A) Short-axis view of the aortic valve showing significant calcification of all leaflets. (B) Doppler flow of aortic valve in long axis showing turbulent flow through a stenotic and calcified valve. (C) Gradient measurements across the aortic valve demonstrating severe stenosis. (D) Aorto–mitral continuity calcifications, typical of radiation-induced cardiotoxicity (arrow) and pericardial thickening and calcifications (arrowhead).



**Figure 2.** Computed tomography scan of the thorax showing vessel calcification. (A) Moderately calcified thoracic aorta. (B) Minimally calcified left internal mammary artery (although poorly visualized).

consented to proceeding in our hybrid operation room for SAVR, with the possibility of converting to TAVR if the ascending aorta was found to be porcelain. She accepted the fact that symptoms might not improve, especially if a component of radiation-induced restrictive cardiomyopathy was causing her dyspnea, which was difficult to determine at that point.

Intraoperatively, the aorta was found to be minimally calcified, so the patient underwent successful SAVR and aortocoronary bypass x2 on-pump. Aortocoronary bypasses with a saphenous vein graft to the obtuse marginal lesion and the left anterior descending artery were completed; given that the internal mammary artery pulse was weak, and its flow was poor, it was discarded. Overall, it was a difficult surgery given the multiple adhesions in the chest requiring dissection, leaving a lot of raw surfaces prone to bleeding, and requiring multiple transfusions. Large doses of vasopressors were required to come off cardiopulmonary bypass secondary to vasoplegia, which persisted for many days.

The patient was discharged from the hospital 3 weeks later. At the 6-month follow-up, she was feeling well, and her dyspnea had improved significantly (New York Heart Association class I). Repeat echocardiogram showed an improved left ventricular ejection fraction of 60%-65%, and a well-seated mechanical aortic valve without stenosis.

## Discussion

This case demonstrates the wide spectrum of cardiovascular complications that can be seen after radiation of the mediastinum. Virtually all components of the heart can be affected—the valves, coronaries, myocardium, pericardium, and the conduction system.<sup>1</sup> The aortic valve is most commonly affected given its proximity with the radiation field, and AS is the most common valve pathology requiring correction.<sup>1</sup>

This case also demonstrates the surgical complexity of these patients. Vessel conduits are often fibrosed and friable, making it difficult to find adequate grafts for bypass.<sup>2</sup> Radiation leads to mediastinal fibrosis, and to adhesions that need to be dissected, are prone to bleeding, and demonstrate poor

healing. Given that these patients are poor surgical candidates, interest has been increasing in catheter-based interventions, and TAVR has been shown to have a decreased 30-day mortality compared to SAVR.<sup>3</sup> This finding has now been replicated in larger studies in which postoperative complications are also less frequent with TAVR, compared with SAVR.<sup>4</sup> The heart-team approach is now recommended by the American and European guidelines for decision-making regarding the treatment modality for AS,<sup>5,6</sup> which is even more relevant in patients with radiation-induced AS, who have a more complex cardiac and mediastinal anatomy that may not be easily amenable to cardiac surgery. This approach is multidisciplinary and patient-specific, taking into consideration the patient's cardiac and general comorbidities, as well as their values and personal preferences. Although these exchanges can be highly technical, the patient should remain at the center of discussions at all times. Hence, multidisciplinary heart-team assessment is paramount for these patients, and consideration should be given to catheter-based approaches.

## Funding Sources

The authors have no funding sources to declare.

## Disclosures

The authors have no conflicts of interest to disclose.

## References

1. Chang HM, Okwuosa TM, Scarabelli T, Moudgil R, Yeh ETH. Cardiovascular complications of cancer therapy: best practices in diagnosis, prevention, and management: part 2. *J Am Coll Cardiol* 2017;70:2552-65.
2. Brown ML, Schaff HV, Sundt TM. Conduit choice for coronary artery bypass grafting after mediastinal radiation. *J Thorac Cardiovasc Surg* 2008;136:1167-71.
3. Zhang D, Guo W, Al-Hijji MA, et al. Outcomes of patients with severe symptomatic aortic valve stenosis after chest radiation: transcatheter versus surgical aortic valve replacement. *J Am Heart Assoc* 2019;8:e012110.

4. Nauffal V, Bay C, Shah PB, et al. Short-term outcomes of transcatheter versus isolated surgical aortic valve replacement for mediastinal radiation-associated severe aortic stenosis. *Circ Cardiovasc Interv* 2021;14:e010009.
5. Nishimura RA, Otto CM, Bonow RO, et al. 2014 AHA/ACC guideline for the management of patients with valvular heart disease: executive summary: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *J Am Coll Cardiol* 2014;63:2438-88.
6. Vahanian A, Alferi O, Andreotti F, et al. Guidelines on the management of valvular heart disease (version 2012): the Joint Task Force on the Management of Valvular Heart Disease of the European Society of Cardiology (ESC) and the European Association for Cardio-Thoracic Surgery (EACTS). *Eur J Cardiothorac Surg* 2012;42:S1-44.