THE TEXAS HEART INSTITUTE® JOURNAL

Case Reports

Complex Tricuspid and Pulmonic Carcinoid Heart Disease With Timely Surgical Repair

John Hollowed, MD[1]; Hawkin Woo, MD[2]; Solomon Hamburg, MD, PhD[3]; Abbas Ardehali, MD[4]

[1]Division of Cardiology, University of California, Los Angeles, Los Angeles, California
[2]Department of Medicine, University of California, Los Angeles, Los Angeles, California
[3]Division of Hematology Oncology, University of California, Los Angeles, Los Angeles, California
[4]Division of Cardiothoracic Surgery, University of California, Los Angeles, Los Angeles, California

Abstract

A 63-year-old man with a history of hypertension, prediabetes, and sleep apnea presented with pedal edema, weight loss, and flushing. Laboratory work revealed elevated B-type natriuretic peptide and normocytic anemia. Echocardiography showed right ventricular enlargement, severe tricuspid valve regurgitation, and thickened tricuspid valve leaflets, raising suspicion for carcinoid heart disease. Further testing confirmed a neuroendocrine tumor with liver metastasis. Despite somatostatin therapy, the patient's symptoms were refractory to diuretics. Surgical intervention with tricuspid and pulmonary valve replacement was undertaken. Postoperatively, the patient demonstrated substantial improvement in functional tolerance and quality of life. This case highlights the importance of surgical intervention in advanced carcinoid heart disease.

Keywords: Tricuspid regurgitation; valvular heart disease; pulmonary regurgitation; carcinoid heart diseases

Case Report

Presentation and Physical Examination

A 63-year-old man with a medical history of hypertension, prediabetes, and sleep apnea presented to the emergency department with bilateral pedal edema, unexplained weight loss, and occasional flushing. Laboratory work was notable for a mildly elevated B-type natriuretic peptide of 112 ng/L (reference range, <100 ng/L) and mild normocytic anemia, with a hemoglobin of 115 g/L (reference range, >135 g/L). Of note, liver function testing was normal. His examination was notable for 1+ bilateral pitting edema along with mild scrotal edema and a systolic murmur. He was treated with a loop diuretic, and an outpatient echocardiogram was obtained. The echocardiogram revealed preserved left ventricular function, but there was new right ventricular (RV) enlargement, with a right to left ventricle ratio of 1.27, with preserved RV systolic function. There was wide-open tricuspid valve regurgitation and severely thickened and restricted tricuspid valve leaflets (Fig. 1), moderate pulmonary valve regurgitation, and a patent foramen ovale. This was a clinically significant change from the echocardiogram 12 years before, which had shown normal heart valve structure and function. An abdominal ultrasound scan was obtained as part of the workup for unexplained edema. This scan was notable for numerous liver lesions of varying characteristics (cystic and solid) up to 6.9 cm in size. It was with this background that the patient was first seen in the clinic.

Citation: Hollowed J, Woo H, Hamburg S, Ardehali A. Complex tricuspid and pulmonic carcinoid heart disease with timely surgical repair. *Tex Heart Inst J*. 2025;52(2):e258599. doi:10.14503/THIJ-25-8599
Corresponding author: John Hollowed, MD, 2020 Santa Monica Blvd, Ste 220, Santa Monica, CA 90404 (jhollowed@mednet.ucla.edu)

Differential Diagnosis

The primary focus was concern for carcinoid heart disease. The characteristic appearance of the tricuspid valve with severe tricuspid valve insufficiency, along with hepatic lesions, raised concern for a possible neuroendocrine tumor of the liver and resulting carcinoid syndrome. Primary tricuspid valve regurgitation from RV dilation would not cause such marked retraction of the valve leaflets. Pulmonary embolus would not cause the morphologic changes seen on the tricuspid valve. Furthermore, the patient did not have risk factors for rheumatic heart disease, and there was no evidence of left-sided heart valve involvement. Congenital tricuspid valve abnormalities were excluded using a prior echocardiogram, which showed no valve disease. Finally, the patient had had no sequelae of infective endocarditis and no risk factors for right-sided valve infection.

Technique

Serum and urine testing confirmed carcinoid heart disease. The patient's serum serotonin levels were markedly elevated, at 6.62 μmol/L (reference rage, 0.28-1.25 μmol/L), as was the 24-hour urine 5-hydroxyindoleacetic acid collection, at 371 mg/d (reference range, <15 mg/d). A magnetic resonance cholangiopancreatography test was performed that showed numerous hepatic lesions and diffuse lymphadenopathy adjacent to the liver. Biopsy revealed the lesion to be a neuroendocrine tumor, grade 2. Positron emission tomography/computed tomography showed avid metastatic disease involving the liver and lymph nodes as well as ileum and peritoneal carcinomatosis. The patient was started on octreotide injections but continued to have volume overload, dyspnea, and fatigue refractory to aggressive diuretics. He had New York Heart Association (NYHA) class III symptoms and was unable to work. The decision was made to proceed with tricuspid valve replacement. A perioperative transesophageal echocardiogram showed a severe, wide-open tricuspid valve and severe pulmonary valve regurgitation (Fig. 2). Left-sided heart valves appeared normal. The patient underwent tricuspid valve replacement with a 27-mm bioprosthetic valve, pulmonary valve replacement with a 29-mm bioprosthetic valve, patch enlargement of the RV

Key Points

- Carcinoid heart disease is a complex disease process with high mortality rates if left untreated.
- Carcinoid heart disease commonly presents with right heart failure symptoms and peripheral and hepatic edema.
- Symptom improvement is likely after heart valve replacement for severe disease.
- Progression of cardiac involvement does not seem to be halted by systemic control of the disease, so heart valve replacement becomes essential to improve RV function.

Abbreviations

NYHA, New York Heart Association
RV, right ventricular

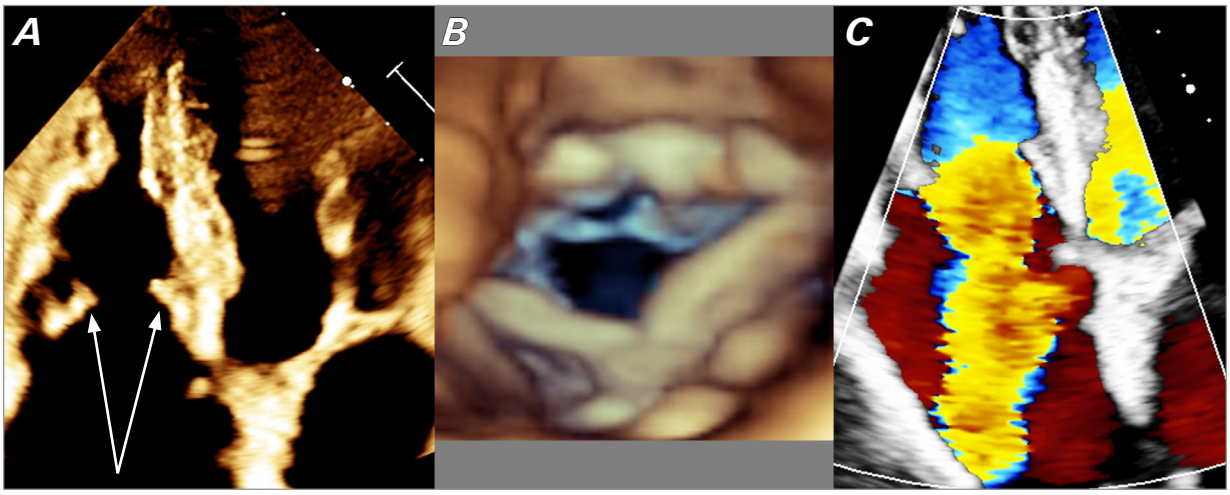

Fig. 1 (**A**) Transthoracic echocardiogram (apical view) shows severely retracted tricuspid valve leaflets (arrows) and a wide gap of noncoaptation. (**B**) Transthoracic echocardiogram short-axis shows a 3-dimensional view of the tricuspid valve in systole with a large area of noncoaptation. (**C**) Color Doppler shows severe, wide-open tricuspid valve regurgitation.

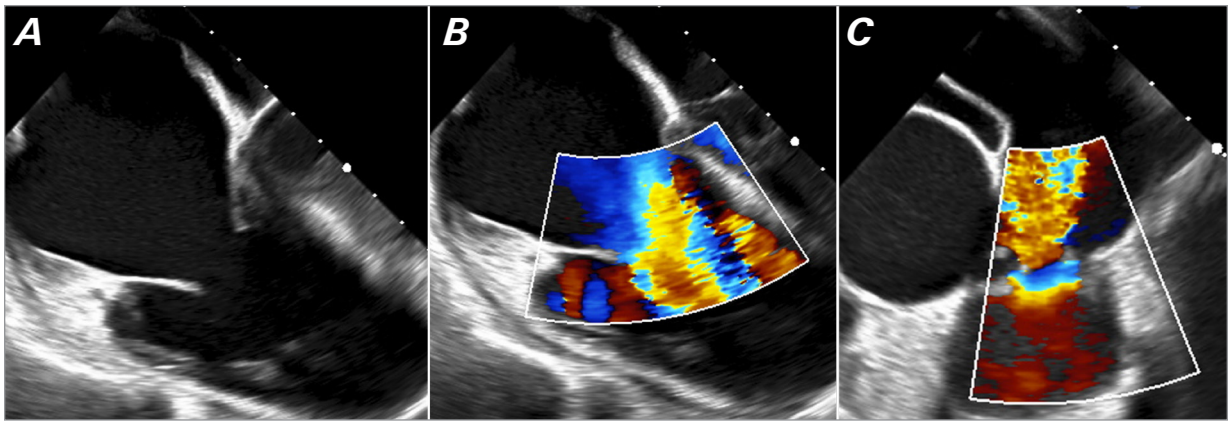

Fig. 2 (**A**) Transesophageal echocardiogram shows the tricuspid valve in systole, with immobile, retracted leaflets. (**B**) Color Doppler shows severe, wide-open tricuspid valve regurgitation and (**C**) severe pulmonary valve regurgitation.

outflow tract, and repair of the patent foramen ovale. At the end of the surgery, the patient was unable to come off cardiopulmonary bypass. There was concern for possible hypovolemia and some RV stunning. He needed high-dose vasopressors, fluids, and inotropic support. In addition, the patient was given intravenous push followed by continuous infusion of octreotide. The octreotide was given for roughly 24 hours because the patient made rapid improvement. The monthly octreotide injections were eventually resumed in the outpatient setting.

Outcome

The patient's postoperative course was uneventful, and after further diuresis, he had notably improved functional tolerance and quality of life. An echocardiogram obtained roughly 2 months after surgery showed normal prosthetic valve function and clinically significant improvement in RV size and estimated right-sided pressure. During his last clinic visit, he reported substantially improved energy and the desire to go back to work and continue with cardiac rehabilitation.

Discussion

Carcinoid heart disease can be a devastating process that results from carcinoid syndrome. This disorder is driven by the secretion of bioactive amines, most prominently serotonin and its by-products, from neuroendocrine tumors. In 20% to 50% of patients with carcinoid syndrome, there will be cardiac involvement during the disease course, which has a substantial impact on survival.[1] The cardiac manifestations develop from fibrosis and plaque deposition, with resulting heart valve dysfunction that most commonly affects the right-sided heart valves, which are the most exposed to the bioactive amines. There can be annular restriction and marked degeneration of the leaflets, leading to severe retraction and regurgitation.[2] Tricuspid valve regurgitation is extremely common, occurring in 92% to 100% of patients with cardiac involvement, with pulmonary valve stenosis and regurgitation being the next-most common findings. Left-sided disease is much less common.[3]

In the 2017 *Journal of the American College of Cardiology* state-of-the-art review on the subject, Davar et al[4] suggested a cutoff of 5-hydroxyindoleacetic acid greater than 300 μmol per 24 hours as a useful marker for identifying patients at risk of developing carcinoid heart disease. N-terminal pro–B-type natriuretic peptide monitored serially can also be helpful in identifying patients early with clinically significant carcinoid heart disease. Of course, serial echocardiographic monitoring is the mainstay of surveillance and, based on the severity of disease, can be performed at varying frequencies, leading up to consideration of the need for surgical valve replacement. The medical treatment of carcinoid heart disease starts with long-acting somatostatin analogues, which have been shown to help slow progression of the disease. In patients who are refractory to this therapy, however, there is evidence that the addition of interferon-α; peptide receptor radionuclide therapy; or telotristat etiprate, an oral serotonin synthesis inhibitor, can be beneficial. Figure 3 summarizes this consensus management of carcinoid heart disease in the presurgical period.

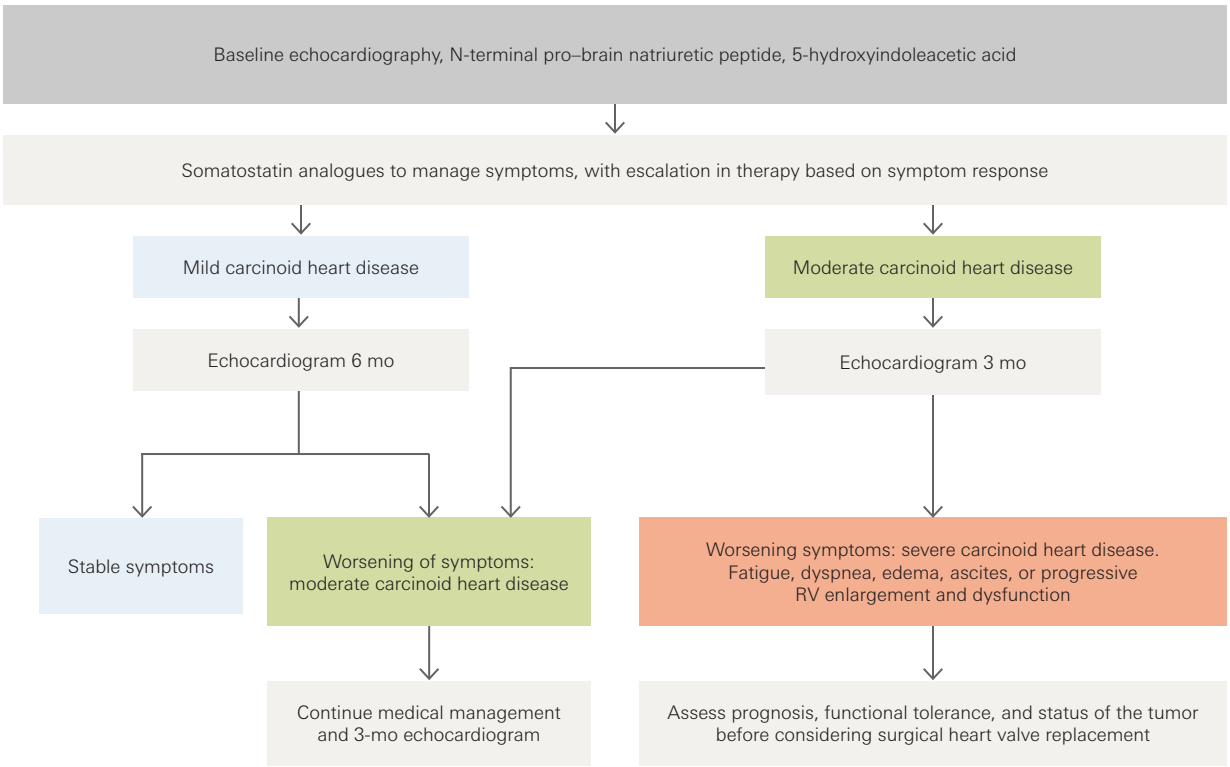

Fig. 3 Consensus-driven management of carcinoid heart disease.
RV, right ventricular.

The decision on the timing of valve intervention is complex and nuanced, based on prognosis and degree of valve and right heart dysfunction.[5] In patients with severe cardiac involvement, mortality rates are dismal, with only 10% survival 2 years after onset of NYHA III or IV symptoms.[6,7] Despite the complexity of treating patients with advanced carcinoid valve disease, many who attain systemic control have an acceptable perioperative risk profile when treated by a multidisciplinary team at an experienced center. Valve type choice seems to favor prosthetic over mechanical, given concerns about bleeding risk due to underlying tumor burden while the patient is on a vitamin K antagonist.[8] Because of the rarity of the disease, it is difficult to find randomized controlled trial data on nonoperative vs operative outcomes, but from the available evidence, perioperative mortality appears low (6%) in experienced centers, and rates of 10-year freedom from reoperation are favorable. Connolly et al[8] reported that in their study of 195 patients who had undergone surgical valve replacement for limiting preoperative symptoms of carcinoid heart disease (NYHA functional class III or IV), symptomatic improvement was noted in 69 of 92 (75%) patients, and 118 of 155 (76%) patients were in NYHA functional class I or II at follow-up. The choice of valve type must be individualized to the patient, their comorbid disease state, and long-term prognosis, however. The North American Neuroendocrine Tumor Society Consensus Guidelines for Surveillance and Medical Management of Midgut Neuroendocrine Tumors from 2017 stated that the general trend is toward bioprosthetic valves because patients can be weaned off anticoagulation therapy, decreasing the risk of bleeding. If the patient can tolerate anticoagulation, however, consideration of a mechanical prosthesis is reasonable because of the potential protection from early valve deterioration. The choice is complex, and robust data are lacking at present.[9]

Carcinoid heart disease can be an extremely complex entity with a substantial risk of mortality, but if it is managed in an experienced center, clinically significant

symptomatic improvement can be achieved with surgical valve replacement. This patient was treated using this approach and thus far has had a positive response to treatment by his multidisciplinary team.

Article Information

Published: 9 July 2025

Author Contributions: J. Hollowed is the primary author. H. Woo, S. Hamburg, and A. Ardehali are contributing authors.

Conflict of Interest Disclosure: None.

Funding/Support: None.

References

1. Algeri L, Falkman L, Spada F, et al. Carcinoid heart disease in patients with advanced small-intestinal neuroendocrine tumors and carcinoid syndrome: a retrospective experience from two European referral centers. *ESMO Open*. 2024;9(11):103959. doi:10.1016/j.esmoop.2024.103959
2. Yuan SM. Valvular disorders in carcinoid heart disease. *Braz J Cardiovasc Surg*. 2016;31(5):400-405. doi:10.5935/1678-9741.20160079
3. Robiolio PA, Rigolin VH, Wilson JS, et al. Carcinoid heart disease. Correlation of high serotonin levels with valvular abnormalities detected by cardiac catheterization and echocardiography. *Circulation*. 1995;92(4):790-795. doi:10.1161/01.cir.92.4.790
4. Davar J, Connolly HM, Caplin ME, et al. Diagnosing and managing carcinoid heart disease in patients with neuroendocrine tumors: an expert statement. *J Am Coll Cardiol*. 2017;69(10):1288-1304. doi:10.1016/j.jacc.2016.12.030
5. Møller JE, Connolly HM, Rubin J, Seward JB, Modesto K, Pellikka PA. Factors associated with progression of carcinoid heart disease. *N Engl J Med*. 2003;348(11):1005-1015. doi:10.1056/NEJMoa021451
6. Connolly HM, Nishimura RA, Smith HC, Pellikka PA, Mullany CJ, Kvols LK. Outcome of cardiac surgery for carcinoid heart disease. *J Am Coll Cardiol*. 1995;25(2):410-416. doi:10.1016/0735-1097(94)00374-y
7. Møller JE, Pellikka PA, Bernheim AM, Schaff HV, Rubin J, Connolly HM. Prognosis of carcinoid heart disease: analysis of 200 cases over two decades. *Circulation*. 2005;112(21):3320-3327. doi:10.1161/CIRCULATIONAHA.105.553750
8. Connolly HM, Schaff HV, Abel MD, et al. Early and late outcomes of surgical treatment in carcinoid heart disease. *J Am Coll Cardiol*. 2015;66(20):2189-2196. doi:10.1016/j.jacc.2015.09.014
9. Strosberg JR, Halfdanarson TR, Bellizzi AM. The North American Neuroendocrine Tumor Society consensus guidelines for surveillance and medical management of midgut neuroendocrine tumors. *Pancreas*. 2017;46(6):707-714. doi:10.1097/MPA.0000000000000850