Cardiac Tamponade From Compression of the Pulmonary Arterial Outflow Graft of a Biventricular Assist Device

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A 19-year-old patient with a Thoratec Paracorporeal Biventricular Assist Device implanted 15 weeks previously complained of discomfort in his back and chest area, lightheadedness, and diaphoresis, and was noted to have a blood pressure of 62/26 mm Hg. Device alarms sounded for both the left and right ventricular assist devices indicating that the paracorporeal pumps were not filling normally.

An ECG showed sinus tachycardia with low voltage (Figure 1). A portable chest radiograph showed enlargement of the cardiac silhouette, loss of the left hemidiaphragmatic contour, and mild left midlung atelectasis (Figure 2). Trans-thoracic and transesophageal echocardiography showed a large pericardial hematoma with compression of the right ventricle and diastolic compression of the pulmonary arterial outflow graft (Figure 3 and Movies I and II in the online-only Data Supplement). The aortic outflow graft and the right atrium did not appear to be compressed. Computed tomographic scanning confirmed the extent of the pericardial hematoma and demonstrated a mass effect on the right ventricle (Figure 4).

After minimal response to fluid boluses and an increased pressor requirement, the patient was taken to surgery and the hematoma was evacuated. The cause of the hematoma was determined intraoperatively to be a small perforation, of unclear origin, in the left ventricular outflow graft. The perforation was closed surgically. Postoperative transesophageal echocardiography showed a small, residual circumferential pericardial effusion without any compression of the outflow grafts (Figure 5 and Movies III and IV in the online-only Data Supplement). The patient’s hemodynamics improved significantly.

Discussion

The Thoratec Paracorporeal Ventricular Assist Device (Thoratec Corporation, Pleasanton, CA) is a pneumatically driven, pulsatile pump system that supports the right, left, or both ventricles in patients requiring mechanical circulatory support for either...
bridge-to-recovery or bridge-to-transplantation indications.1 The device rests in a paracorporeal position (ie, the pump housing rests externally against the chest wall) with the inflow and outflow cannulas connecting to the heart and great vessels transcutaneously. The outflow cannulas connect to the great arteries via polyester arterial grafts measuring 14 mm to 18 mm in diameter.1

In our patient, external compression of the pulmonary arterial outflow graft likely led to obstruction of blood flow to the pulmonary vasculature and decrease in the left ventricular preload, resulting in hypotension and other symptoms of low cardiac output. Because the right ventricle was bypassed by the right ventricular assist device, compression of the right ventricle by the pericardial hematoma likely did not affect the patient’s hemodynamics significantly.

Echocardiography provides valuable diagnostic imaging in patients with ventricular assist device malfunction and postimplant complications.2,3 Potential causes of device malfunction identifiable by echocardiography include inflow valve regurgitation, inflow and outflow cannula obstruction, kinking of the outflow graft, intracardiac thrombus, and new insufficiency of the native aortic valve.2,3 In a similar recent report4 and our case, echocardiography demonstrated the external compression of the pulmonary arterial outflow graft by a pericardial hematoma, thus explaining the cause for hypotension and device malfunction. Echocardiographic evaluation in patients with ventricular assist device malfunction should include routine assessment of the arterial outflow grafts.

Disclosures
None.

References

Figure 2. Portable chest radiograph showing enlargement of the cardiac silhouette, loss of the left hemidiaphragmatic contour, and mild left midlung atelectasis.

Figure 3. Echocardiographic still images showing a large pericardial hematoma with diastolic compression of the pulmonary arterial outflow graft. (A) Systolic frame of the cross-section of the graft (arrow). (B) Diastolic frame of the cross-section of the graft showing compression (arrow). (C) Guide to the structures seen in panels A and B. (D) Systolic frame of the longitudinal section of the graft (arrow). (E) Diastolic frame of the longitudinal section of the graft showing compression (arrow). (F) Guide to the structures seen in panels D and E. 1 indicates pericardial hematoma; 2, aortic outflow graft; 3, pulmonary arterial outflow graft in systole (dashed line); 4, compressed pulmonary arterial outflow graft in diastole (solid line); and 5, compressed right ventricular cavity.
Figure 4. Noncontrast axial computed tomographic scan showing the pericardial hematoma surrounding the outflow grafts to the aorta and the pulmonary artery, and compressing the right ventricle. (A) Noncontrast axial computed tomographic scan. (B) Guide to the structures seen in panel A. 1 indicates pericardial hematoma; 2, aortic outflow graft; 6, right atrial inflow cannula; and 7, pulmonary arterial outflow graft.

Figure 5. Postoperative echocardiographic still images after evacuation of the pericardial hematoma showing a small, residual pericardial effusion without significant compression of the pulmonary arterial outflow graft. (A) Systolic frame of the cross-section of the graft (arrow). (B) Diastolic frame of the cross-section of the graft showing no significant compression (arrow). (C) Guide to the structures seen in panels A and B. (D) Systolic frame of the longitudinal section of the graft (arrow). (E) Diastolic frame of the longitudinal section of the graft showing no significant compression (arrow). (F) Guide to the structures seen in panels D and E. 2 indicates aortic outflow graft; 8, pulmonary arterial outflow graft in diastole (solid line) showing no significant compression; and 9, small residual pericardial effusion.
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Circulation. 2012;126:e261-e263
doi: 10.1161/CIRCULATIONAHA.112.112557
Circulation is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
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Print ISSN: 0009-7322. Online ISSN: 1524-4539

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://circ.ahajournals.org/content/126/17/e261

Data Supplement (unedited) at:
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