An Unusual Cause of Dyspnea Diagnosed Late in Life
Severe Pulmonary Hypertension Resulting From Isolated Anomalous Pulmonary Venous Connection

Jonathan C. Clarke, MD; Jayashri R. Aragam, MD; Deepak L. Bhatt, MD, MPH; Jonathan D. Brown, MD; Sarah Ferrazzani, PA; Daniel A. Pietro, MD; Bradley A. Maron, MD

A 67-year-old US military veteran was referred to our clinic for evaluation of progressive dyspnea on exertion over the previous 2 years. His medical history was significant for systemic hypertension, obstructive sleep apnea, and the absence of primary lung disease, significant tobacco use, or coronary artery disease. At the time of consultation, his peripheral blood oxygenation saturation was 85%, hepatorenal reflux and lower-extremity edema were noted, and 6-minute walk distance was 34 m.

Transcatheter echocardiography demonstrated normal left ventricular systolic structure and function, a severely dilated right ventricle, and a tricuspid regurgitant jet velocity of 4.85 m/s, indicating an estimated pulmonary artery systolic pressure of 94 mm Hg. However, an elevated flow velocity of 65 cm/s was detected by Doppler interrogation of the posterior aspect of the right atrium adjacent to the interatrial septum. To investigate this further, transesophageal echocardiography was performed, which demonstrated a 1.2-cm communication between the right upper pulmonary vein and the superior vena cava (Figure 1A) and a respirophasic bidirectional shunt through this lesion (Figure 1B and Video I in the online-only Data Supplement). Three-dimensional echocardiography (Figure 2A and Video II in the online-only Data Supplement) and multislice 3-dimensional reconstructive computed tomographic angiography (Figure 2B) characterized the defect further and confirmed a normal anatomic origin and insertion of the right upper pulmonary vein at the right upper lobe of the lung and left atrium, respectively.

Partial anomalous pulmonary venous connection (PAPVC) describes a rare congenital disease present in up to 0.7% of the general population and is characterized most often by the terminal insertion of a pulmonary vein into the right atrium or superior vena cava in conjunction with a sinus venosus atrial septal defect. The present case illustrates an isolated anomalous pulmonary vein without an associated atrial septal defect. This anomaly is believed to result from failure of the splanchnic plexus–derived pulmonary vasculature to separate completely from the right common cardinal vein, which is the embryological precursor of the superior vena cava. Thus, the patient’s anatomic anomaly is distinct from the conventional sinus venosus atrial septal defect–associated PAPVC because of the unroofing of the common wall between the right upper pulmonary vein and the sinus venosus myocardium, allowing for the superior region of the atrial septum to remain intact.

Isolated PAPVC has been described previously in the pediatric literature but is an exceedingly uncommon diagnosis in adults. We believe this patient’s adulthood presentation is explained, in part, by right-to-left shunt pathophysiology that occurred, ultimately, as a result of severe pulmonary arterial hypertension from PAPVC-dependent increased pulmonary blood flow, chronic systemic hypertension, and obstructive sleep apnea. Surgical closure of the defect with the Warden procedure, which creates a baffle separating the pulmonary from the venous return, is the preferred treatment strategy. However, if surgery is not an option, catheter-based interventions with vascular occlusion coils have been reported. Notable potential complications of these procedures include superior vena cava stenosis and pulmonary edema because of instrumentation injury resulting in obstruction of the repaired pulmonary vein.

In this case, severe right ventricular systolic dysfunction (ejection fraction, 28%), severe pulmonary hypertension, and complex PAPVC anatomy conspired to elevate the patient’s estimated procedural risk, thereby favoring a pharmacotherapeutic treatment strategy. Various medical therapies to treat symptomatic, severe pulmonary hypertension in association with congenital heart disease have been reported, including phosphodiesterase type-V inhibitors, endothelin receptor antagonists, calcium channel receptor antagonists, and prostacyclin analogs. In the present case, failure to abrogate the
patient’s severe pulmonary hypertension or symptom burden after therapy with maximum-dose phosphodiesterase type-V inhibition resulted in initiation of parenteral prostacyclin replacement therapy, which improved the patient’s shortness of breath and functional capacity substantially and increased his 6-minute walk distance to 330 m.

Although isolated PAPVC is rare, we believe that greater awareness among the practicing clinical cardiology community is necessary to prevent the delayed or missed diagnosis of these and other potentially important extracardiac circulatory anomalies in patients with otherwise unexplained pulmonary hypertension and heart failure symptoms.

Acknowledgments
We wish to acknowledge Diane Lapsley and Hope McChesney for their expert technical assistance in preparing the figures for this article.
Sources of Funding
This work was supported in part by the American Heart Association (11POST6720000) and the Lerner Foundation at Brigham and Women’s Hospital (Dr Maron).

Disclosures
Dr Maron is a recipient of the Gilead Young Investigator Research Grant. Dr Bhatt has served on the advisory board for Medscape Cardiology; on the board of directors for Boston VA Research Institute and Society of Chest Pain Centers; and as chair of the American Heart Association Get With The Guidelines Science Subcommittee. Dr Bhatt has received honoraria from the American College of Cardiology (editor, Clinical Trials, Cardiosource), Duke Clinical Research Institute (clinical trial steering committees), Slack Publications (chief medical editor, Cardiology Today Intervention), WebMD (CME steering committees). Dr Ghatt has been senior associate editor, Journal of Invasive Cardiology and has received research grants from Amarin, AstraZeneca, Bristol-Myers Squibb, Eisai, Ethicon, Medtronic, Sanofi Aventis, and The Medicines Company. Dr Bhatt has performed unfunded research for FlowCo, PLx Pharma, and Takeda. The other authors have no conflicts to report.

References

Key Words: anomalous pulmonary vein • congenital heart disease • pulmonary hypertension
An Unusual Cause of Dyspnea Diagnosed Late in Life: Severe Pulmonary Hypertension Resulting From Isolated Anomalous Pulmonary Venous Connection
Jonathan C. Clarke, Jayashri R. Aragam, Deepak L. Bhatt, Jonathan D. Brown, Sarah Ferrazzani, Daniel A. Pietro and Bradley A. Maron

_Circ Cardiovasc Imaging_, 2013;6:349-351
doi: 10.1161/CIRCIMAGING.112.000145
_Circulation: Cardiovascular Imaging_ is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
Copyright © 2013 American Heart Association, Inc. All rights reserved.
Print ISSN: 1941-9651. Online ISSN: 1942-0080

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://circimaging.ahajournals.org/content/6/2/349

Data Supplement (unedited) at:
http://circimaging.ahajournals.org/content/suppl/2013/03/18/6.2.349.DC1

**Permissions:** Requests for permissions to reproduce figures, tables, or portions of articles originally published in _Circulation: Cardiovascular Imaging_ can be obtained via RightsLink, a service of the Copyright Clearance Center, not the Editorial Office. Once the online version of the published article for which permission is being requested is located, click Request Permissions in the middle column of the Web page under Services. Further information about this process is available in the Permissions and Rights Question and Answer document.

**Reprints:** Information about reprints can be found online at:
http://www.lww.com/reprints

**Subscriptions:** Information about subscribing to _Circulation: Cardiovascular Imaging_ is online at:
http://circimaging.ahajournals.org//subscriptions/