Circulation

FREE ACCESS | ARTICLE

IMAGING AND NUCLEAR MEDICINE
SESSION TITLE: ECHOCARDIOGRAPHY: STRUCTURAL HEART DISEASE AND INTERVENTIONS

Abstract 16775: Severity Assessment of Transcatheter Aortic Valve Paravalvular Regurgitation: A New Approach Based on the Leakage Momentum Flux

Koohyar Vahidkhah, Mohammed S Barakat, and Ali N AzadaniDept of Mechanical and Materials Engineering, Univ Of Denver, Denver, CO

Originally published 14 Nov 2017 | Circulation. 2017;136:A16775

Abstract

Introduction: The circumferential extent (CE) of paravalvular regurgitation (PVR) is commonly used for semiquantitative evaluation of transcatheter aortic valve (TAV) PVR severity. This study points out to the shortcomings of such assessment method.

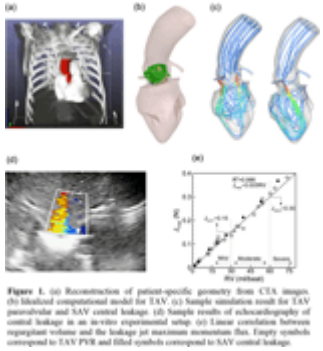
Hypothesis: A novel approach based on fluid mechanics is proposed to evaluate TAV PVR. The method also applies to the central aortic valve regurgitation in surgical aortic valves (SAVs), which is conventionally evaluated by leakage jet width at its origin. The proposed method is based on the estimation of the maximum momentum flux of the leakage flow, J_{max}, from the parameters that are conventionally measured for aortic regurgitation (AR) evaluation: CE of PVR, central jet velocity/width, and the aortic/ventricular pressures.

Methods: A patient-specific geometry of the left ventricle, ascending aorta, and the coronary arteries was reconstructed from computed tomographic angiography (CTA) images (Figure 1a). Idealized computational models of a TAV (Figure 1b) and a SAV with different levels of leakage were then developed. 3D flow fields were simulated (Figure 1c) and used to accurately calculate the regurgitant volume (RV) as well as the corresponding semi-quantitative assessment parameters. In addition, 3D printed TAV and SAV models with different levels of regurgitation were tested in an in-vitro pulse-duplicator system and the aforementioned parameters for AR evaluation were obtained using Doppler echocardiography (Figure 1d).

Results: The results demonstrated a considerable inaccuracy in assessment of TAV PVR severity via CE of PVR. In addition, the computational results showed a nearly linear correlation (R^2=0.986)

between J_{max}, and RV (Figure 1e), indicating the capability of J_{max} in TAV PVR assessment, and AR in general.

Conclusions: The new approach in assessment of the severity of PVR based on estimation of J_{max} showed a significant improvement in terms of accuracy compared to the commonly used CE of PVR.



Download figure | Download PowerPoint

Footnotes

Author Disclosures: **K. Vahidkhah:** None. **M.S. Barakat:** None. **A.N. Azadani:** None.

Back to top

Circ: Cardiovascular Interventions
Circ: Cardiovascular Quality & Outcomes
Circ: Heart Failure
Circulation Research
Hypertension
Stroke
Journal of the American Heart Association (JAHA)

Journal Information

About Circulation
Editorial Board
Reprints
Customer Service and Ordering Information
AHA Journals RSS Feeds
For International Users
Institutions/Librarians FAQ
For Subscribers
Subscriber Help
Wolters Kluwer Privacy Policy

Subjects

All Subjects
Arrhythmia and Electrophysiology
Basic, Translational, and Clinical Research
Critical Care and Resuscitation
Epidemiology, Lifestyle, and Prevention
Genetics
Heart Failure and Cardiac Disease
Hypertension
Imaging and Diagnostic Testing
Intervention, Surgery, Transplantation
Quality and Outcomes
Stroke
Vascular Disease

Features

Bridging Disciplines
Circulation at Major Meetings
Special Themed Issues
Global Impact of the 2017 ACC/AHA Hypertension Guidelines
Circulation Supplements

Cardiovascular Case Series
ECG Challenge
Hospitals of History
On My Mind
Podcast Archive
- Circulation on the Run
- Subscribe to Circulation on the Run
- #FITFAVES
Circulation Doodle

Resources & Education

AHA Guidelines and Statements
Circulation CME
Information for Advertisers

For Authors & Reviewers

Instructions for Authors
Submission Site
Author Reprints

American Heart Association | American Stroke Association ®

National Center
7373 Greenville Ave.
Dallas, TX 75231

Customer Service