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# A Bileaflet CarboMedics Aortic Valve Prosthesis with a New Unusual "Linear" Central Regurgitant Jet: A Sign of Subtle Incomplete Closure of One Leaflet?

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A 76-year-old retired physician underwent routine follow-up echocardiography for a 29-mm CarboMedics bileaflet mechanical prosthesis (Sorin Biomedica Cardio, Arvada, CO, USA) placed 8 years earlier, for aortic stenosis. A new "linear central" prosthetic aortic regurgitant jet, directed toward the left ventricular septum, was noted by transthoracic echocardiography (TTE) (Fig. 1, movie clips S1 and S2), compared to a TTE 3 years earlier.

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The patient was asymptomatic. Coronary arteriography prior to the aortic valve replacement (AVR) revealed no significant epicardial coronary disease. There was a history of chronic atrial fibrillation. The patient maintained an INR between 2.5 and 3.5 with warfarin, and also took aspirin 81 mg/day. Significant findings on physical exam revealed sharp valve clicks and no diastolic murmur by auscultation.

Because of the unusual color Doppler appearance of the regurgitant jet, both transesophageal echocardiography (TEE) (Fig. 2, movie clip S3) and fluoroscopy of the valve were performed (Fig. 3, movie clip S4). By TEE both leaflets appeared to open and close normally. Presumed

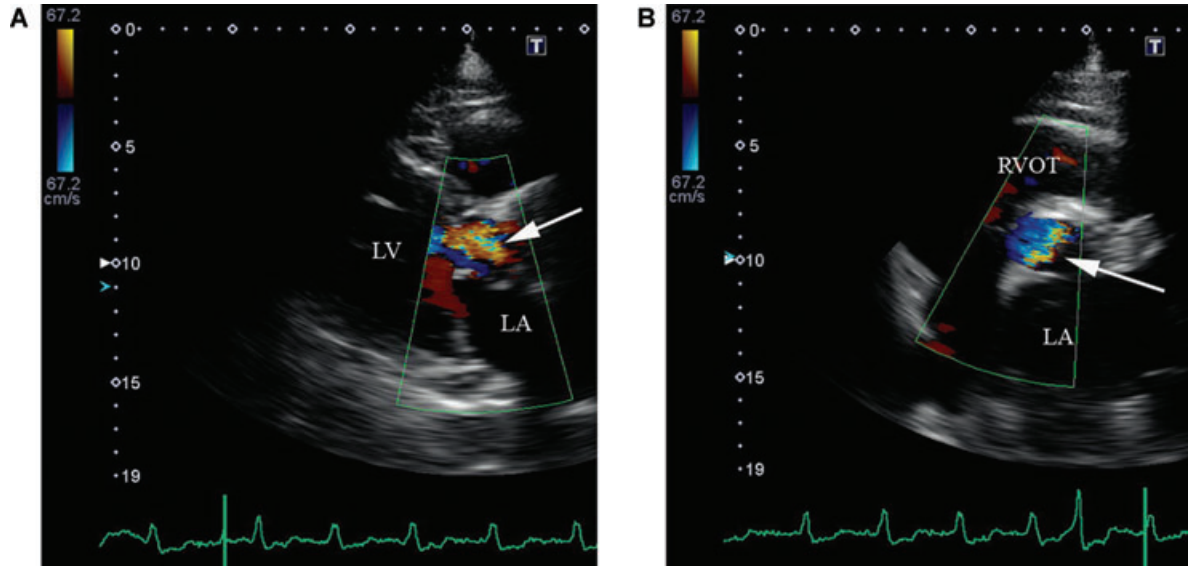



**Figure 1.** Parasternal imaging in diastole. **A.** Long-axis image—a prosthetic valvular color jet directed toward the interventricular septum (arrow). (LA = left atrium; LV = left ventricle). **B.** Short-axis image—the diastolic jet appears to be "central valvular" and "linear" in shape (arrow). (RVOT = right ventricular outflow tract).

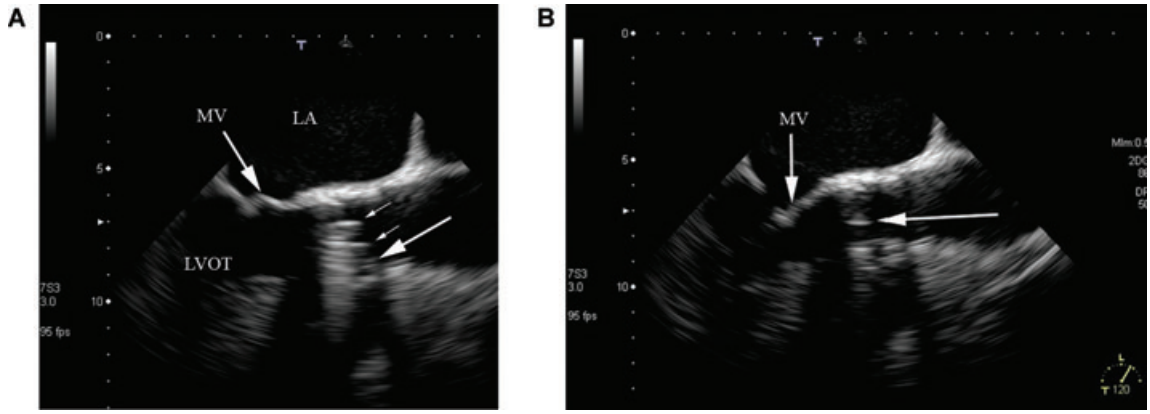
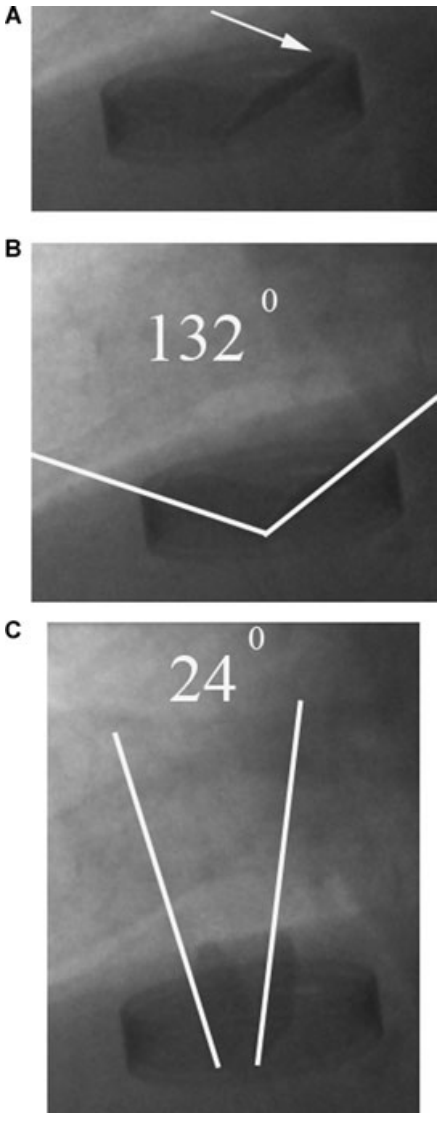



**Figure 2.** TEE in the esophagus at 120°. **A.** Systolic frame—the prosthetic valve leaflets appear to open fully in systole (small arrows). Although suspicious echoes were noted within the valve annulus (arrow), no definite diagnosis of pannus formation could be made from these images. (LVOT = left ventricular outflow tract; MV = mitral valve). **B.** Diastolic frame—the prosthetic valve leaflets appear to fully close (arrow).




pannus formation within the valve annulus could not be definitely demonstrated. By fluoroscopic imaging, one of the leaflets appeared to not close completely within the annulus of the valve (Fig. 3A), despite the fact that the closing angle (132°) was within the normal reported range for that valve.

To further evaluate the linear color jet, a model of a CarboMedics bileaflet valve was evaluated. When both leaflets were completely closed, there was no "space" noted in the central line of closure (Fig. 4A). However, if one leaflet did not completely close, a valvular "central space" was noted (Fig. 4B). This demonstrated space due to incomplete leaflet closure appears to explain the new linear central diastolic color jet observed with this patient. Presumably, no regurgitation in the patient was noted in the paravalvular area secondary to annulus pannus ingrowth abutting the leaflet.

The bileaflet CarboMedics heart valve has been in use since 1986, with no structural valve failure noted through 1997.[1] By fluoroscopy, the normal opening angle between the two leaflets is reported to be 18°–27° and closing angle 128°–136°, with a travel angle of 51°–55°.[2–4] The specified measured leaflet angle of separation from the manufacturer is 10° in the open position.[5] Fluoroscopy is reported to help in identification, as each type of valve has its own radiographic features, and also evaluation functionally,

**Figure 3.** Fluoroscopy of bileaflet tilting disc CarboMedics prosthetic valve. **A.** Diastolic frame reveals that one leaflet does not completely close within the prosthetic valve annulus, but above it (arrow). **B.** Diastolic frame closing angle 132° and **C.** systolic opening angle 24° are within normal reported parameters.

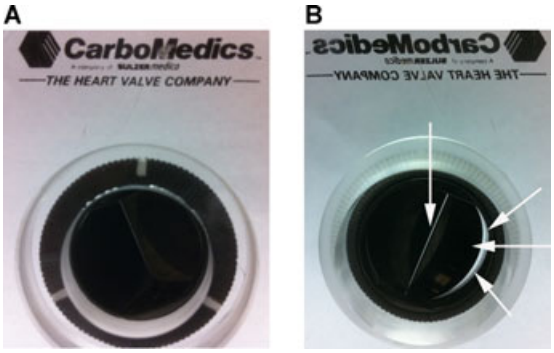



**Figure 4.** Model of CarboMedics bileaflet aortic valve prosthesis. Photograph looking "up" toward the valve, as if viewing from within the left ventricle. **A.** Both leaflets are fully closed. No "space" is found in the central line of closure. **B.** When one leaflet did not completely close (horizontal arrow), a "central space" at the leaflet line of closure (vertical arrow) was noted (Fig. 4B). This space appears to explain the new linear central diastolic color jet. Presumably, a perivalvular leak was not evident, as pannus would "fill" this potential space (diagonal arrows).

particularly with measurement of opening and closing angles.[6,7] It appears that despite "normal" measured opening and closing angles, one leaflet did not completely close within the annulus.

This patient with a bileaflet aortic valve prosthesis presented with a new asymptomatic linear central regurgitant color jet by TTE. TEE suggested normal leaflet opening and closing, and annulus pannus formation could not definitely be demonstrated. Fluoroscopy suggested incomplete closure of one of the leaflets, but with opening and closing angles within normal reported ranges. Using a model of the valve, inadequate closure of one of the leaflets resulted in a central linear space; presumably the etiology of the patient's observed new linear central regurgitant jet. It is presumed that pannus ingrowth (although not definitely demonstrated by TEE) within the valve annulus prevented complete closure of one of the two leaflets. A resultant central valvular "linear space" of incomplete closure and unusual diastolic color jet was noted.

In conclusion, it appears that a new linear central jet of regurgitation may be a sign of subtle incomplete closure of one leaflet in a bileaflet prosthetic valve.

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## Supporting Information

Additional Supporting Information may be found in the online version of this article:

**Movie clip S1.** Parasternal long-axis movie clip demonstrates a valvular diastolic color jet directed toward the interventricular septum.

**Movie clip S2.** Parasternal short-axis movie clip. The diastolic jet appears to be "central valvular" and "linear" in shape.

**Movie clip S3.** TEE in the esophagus at 120°. During systole valve leaflets appear to open fully, and during diastole appear to close fully. Pannus formation could not be diagnosed from these images.

**Movie clip S4.** Fluoroscopy of bileaflet tilting disc CarboMedics prosthetic valve. During valve closure one leaflet does not completely close within the prosthetic valve annulus.

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