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Left Ventricular Apex to Descending Aorta Valved Conduit:

Description of Transthoracic and Transesophageal Echocardiographic Findings in Four Cases

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Patients with critical aortic stenosis and a "porcelain" aorta are at an increased risk for complications with aortic cross-clamping during valve replacement. To our knowledge, this is the first report of both transthoracic and transesophageal echocardiographic findings of the left ventricle to the descending aorta (LVDA) valved conduit. We present results of four patients in whom this procedure was performed for critical aortic stenosis, who also had a porcelain aorta. "Normal" echo and Doppler findings, along with those of development of a regurgitant valve within the conduit, are presented. (ECHOCARDIOGRAPHY, Volume 18, August 2001)

aortic stenosis, LV conduit, porcelain aorta

Surgical correction of aortic valve stenosis routinely involves excision and replacement of the aortic valve. In situations where the ascending aorta is heavily calcified (porcelain aorta), cross-clamping of the aorta prior to valve excision is associated with an increased incidence of embolic complications. One alternative to this is bypass of the entire left ventricular (LV) outflow tract and ascending aorta by placing a left ventricular apical to descending aorta (LVDA) valved conduit. The LVDA procedure has been performed rarely in the past, but a simplified transthoracic surgical approach has recently been developed. A recent report describes seven patients, five of whom survived the procedure.[1] This group used a Bjork-Shiley (Shiley, Inc., Irvine, CA, USA) mechanical tilting disc valve within the conduit in the first three patients, and a St. Jude (St. Jude Medical, Sunnyvale, CA, USA) mechanical bileaflet valve in the next four patients.

To our knowledge, our report is the first to describe transthoracic echocardiographic (TTE) and transesophageal echocardiographic (TEE) findings of these valved conduits in four patients (implanted by our group). In this cohort of patients, a Hancock (Medtronic Inc., Minneapolis, MN, USA) bioprosthetic valve was used within a Dacron graft.

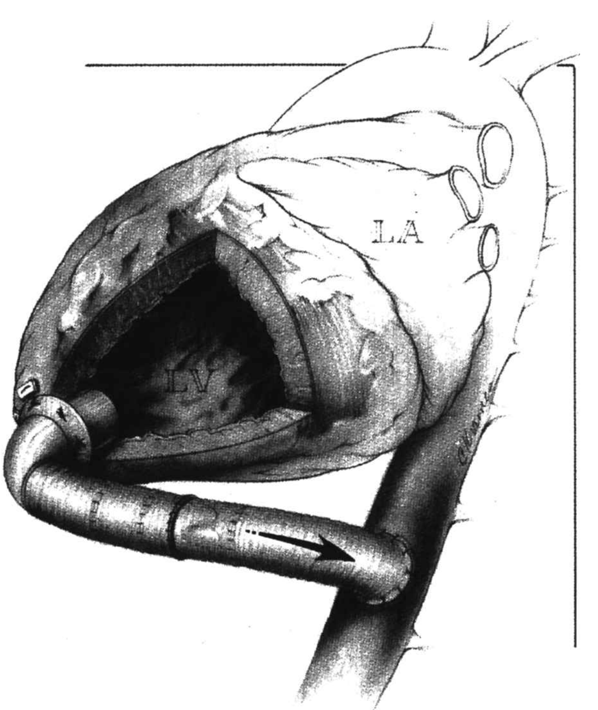

Figure 1. *Drawing of the Hancock Apical Left Ventricle Connector with Valved Conduit. The connector is curved at a 90° angle in order to facilitate anastomosis to the descending aorta (Reprinted with permission from Medtronic, Inc., Medtronic, Inc., 2001.)*

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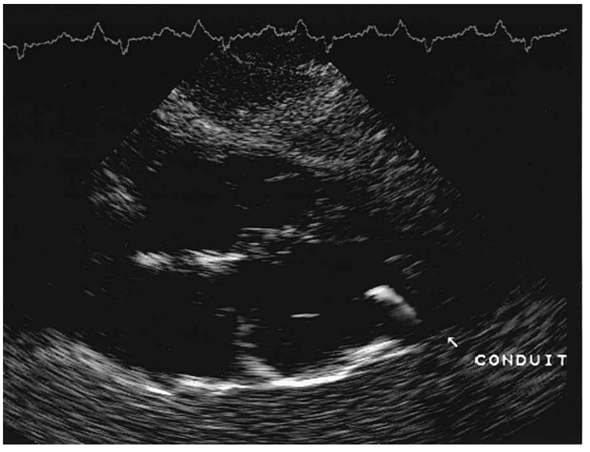

Figure 2. *Subcostal long-axis view demonstrates the insertion site of the conduit into the apex of the LV. (Arrow points to conduit.) LV = left ventricle.*

Patients and Methods

Implantation of an LVDA was performed in four patients with symptomatic critical aortic valve stenosis and a porcelain aorta. They all made an uneventful postoperative recovery. The Hancock LVDA inserts into the apex of the LV. It immediately takes a 90° turn, and then is located approximately in the midportion of the conduit in the valve (Fig. 1).

Since these patients were referred for surgery, baseline preoperative echocardiography by our laboratory was not performed. Postoperative evaluation of the native aortic valve, however, revealed low gradients despite critical aortic stenosis.

Echocardiographic findings are presented in a manner to follow the course of blood flow through the conduit and into the thoracic aorta. Apical and subcostal (Fig. 2) TTE views identified the LV apex-conduit junction in all four patients. Pulsed-wave Doppler identified laminar flow in the proximal portion (Fig. 3) and the distal portion (Fig. 4) of the conduit. The junction of the conduit with the descending aorta was well visualized using TEE (Fig. 5). At this junction, both color-flow and pulsed-wave Doppler (Fig. 6) documented laminar flow in all patients. A brief, early diastolic backflow

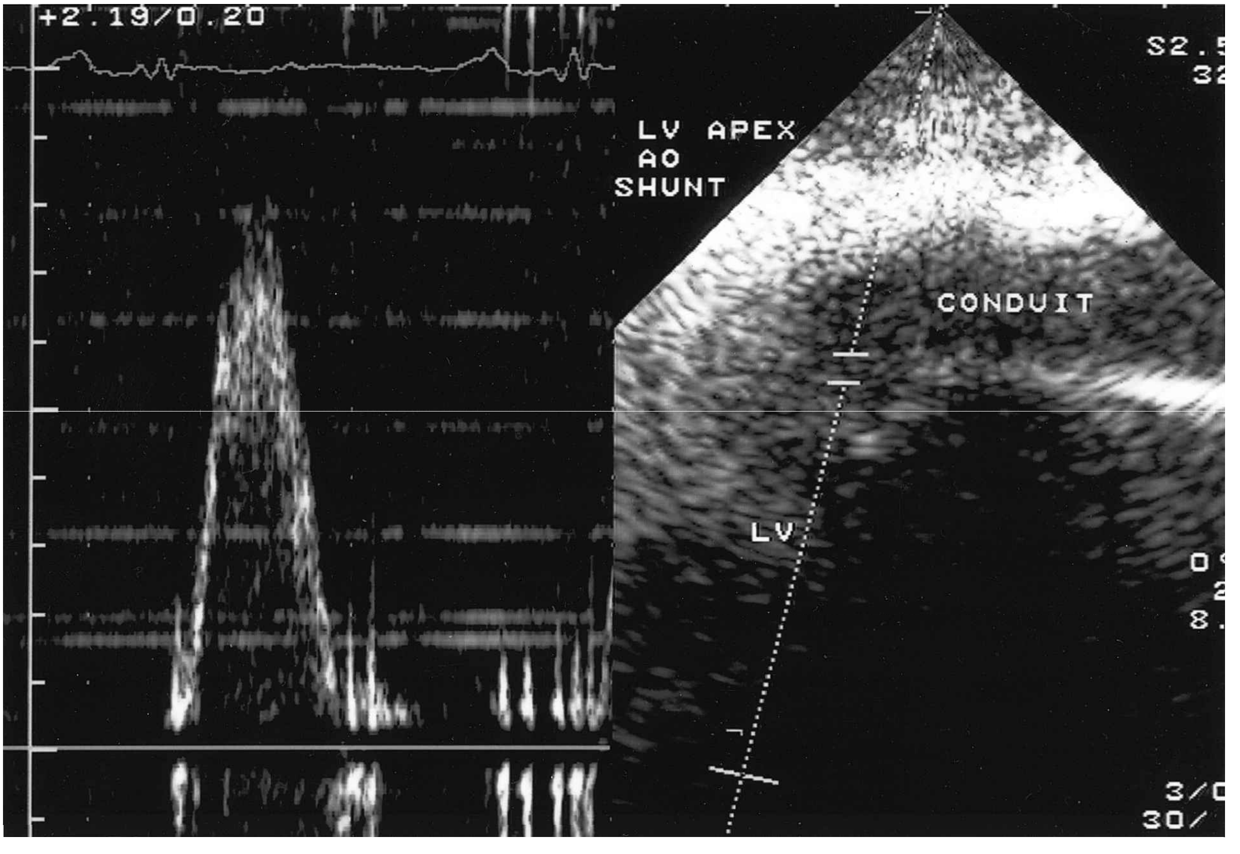

Figure 3. *TTE image with pulsed-wave Doppler from the apex demonstrates laminar conduit flow near the LV-conduit junction. TTE = transthoracic echocardiography; LV = left ventricle.*

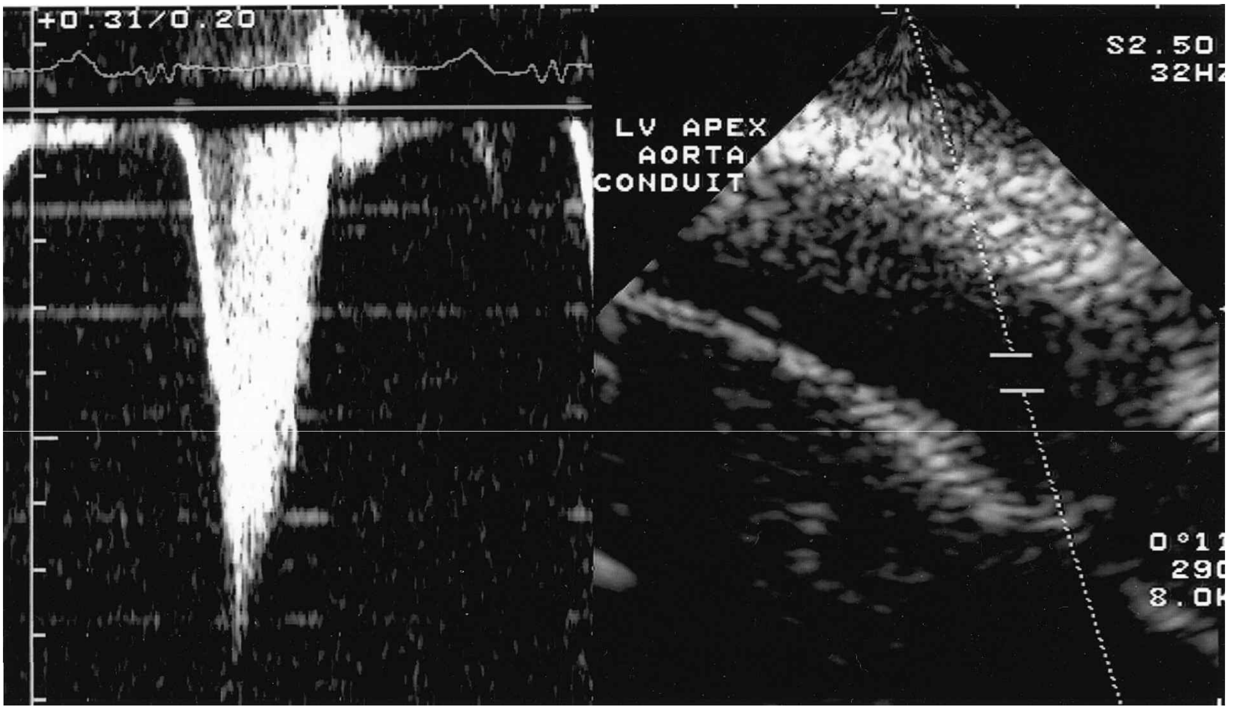

Figure 4. *TTE image with pulsed-wave Doppler demonstrates laminar conduit flow just distal to the site of the Hancock bioprosthetic valve.*

into the conduit seemed to be a normal finding. Direct visualization of the Hancock bioprothesis was not possible by either TTE or TEE in all four patients. After 2 years, one patient developed a new prosthetic regurgitant murmur, which was documented by pulsed-wave (Fig. 7) and color-flow Doppler (Fig. 8).

TTE in the suprasternal notch revealed retrograde systolic flow cephalad in the descending aorta (Fig. 9) and away from the transducer

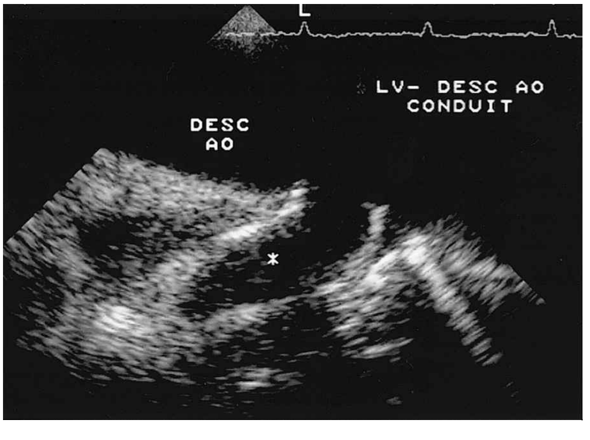

Figure 5. *TEE at 90° demonstrates the conduit-descending aorta junction. TEE = transesophageal echocardiography.*

(towards the aortic valve) in the ascending aorta (Fig. 10). A brief, early "reversed" diastolic flow was also noted by pulsed-wave Doppler.

Discussion

This is the first report to our knowledge of both TTE and TEE findings of LVDA. The surgical procedure was performed in four patients with symptomatic critical aortic stenosis and a porcelain aorta.

Evaluation of the LVDA appears to require both TTE and TEE. Normal findings include identification of the LV-conduit junction, laminar flow within the valved conduit, and retrograde flow in the ascending and descending aorta.

TTE identified relatively low peak velocities across severely stenotic aortic valves, consistent with a majority of blood ejected from the LV through the conduit. The fact that ascending aorta systolic flow was directed retrograde toward the stenotic aortic valve suggests very little flow occurs from the LV through the stenotic aortic valve.

TEE identified the conduit-descending aorta junction as well. Early diastolic retrograde flow was identified in the thoracic aorta by TTE and in the distal conduit by TEE.

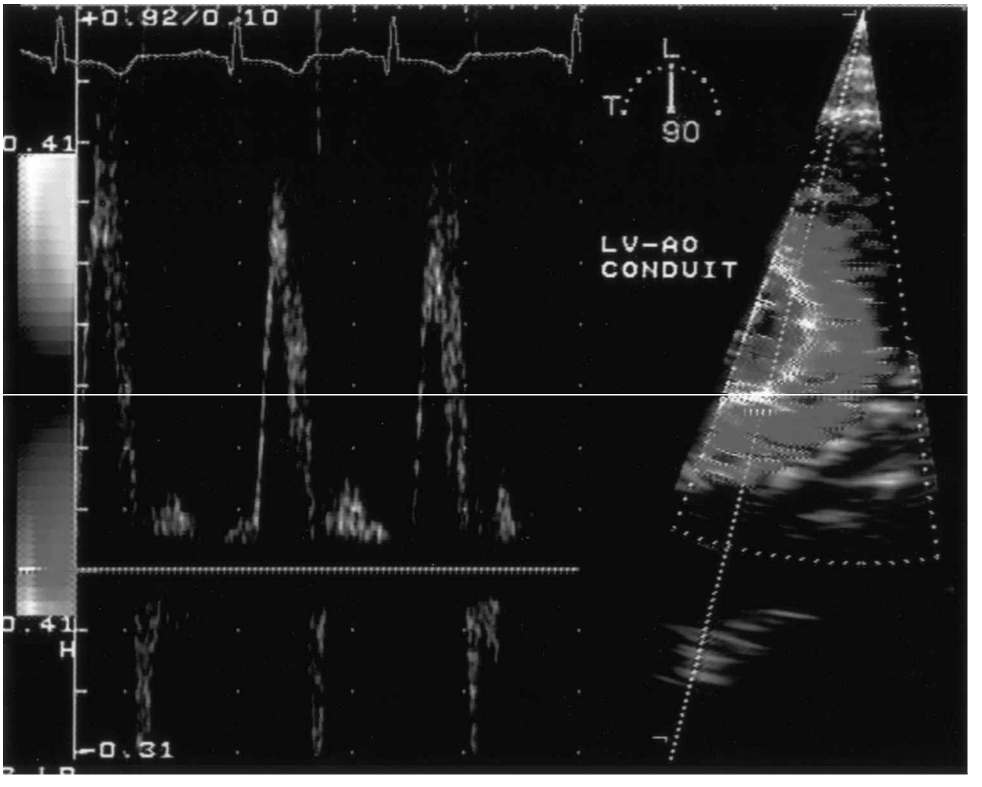

Figure 6. *TEE at 90° with pulsed-wave and color-flow Doppler demonstrates laminar flow at the conduit-descending aorta junction.*

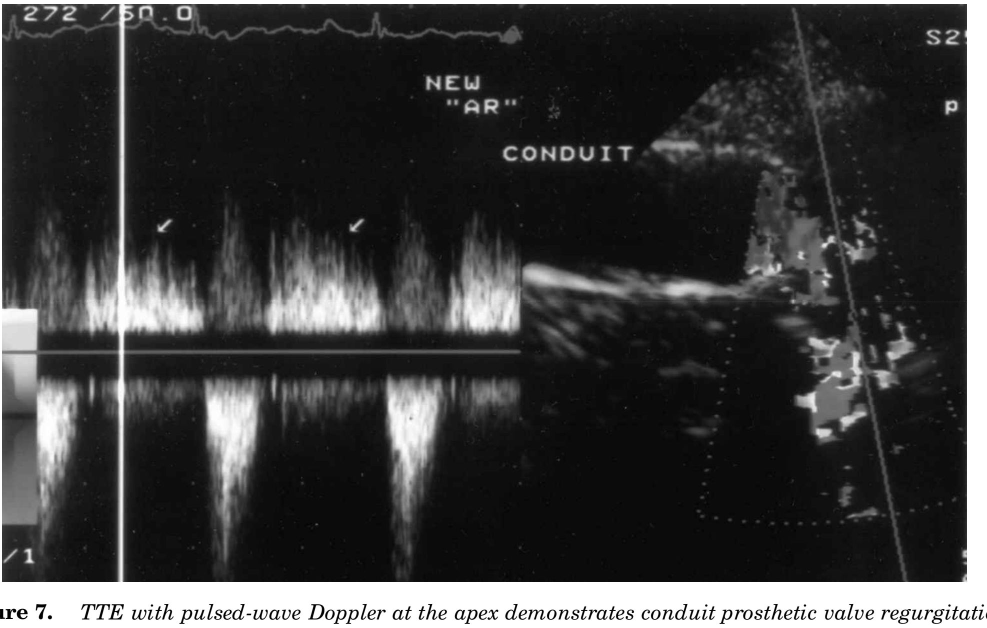

Figure 7. *TTE with pulsed-wave Doppler at the apex demonstrates conduit prosthetic valve regurgitation (arrows).*

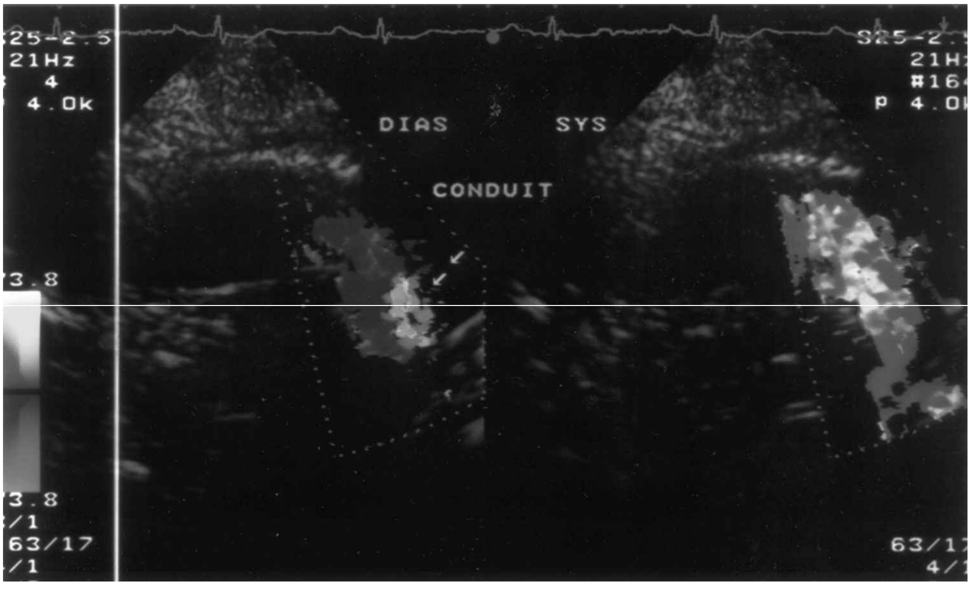

Figure 8. *TTE with color-flow Doppler at the apex demonstrates conduit prosthetic valve regurgitation in diastole (left side) and continued laminar flow in systole (right side).*

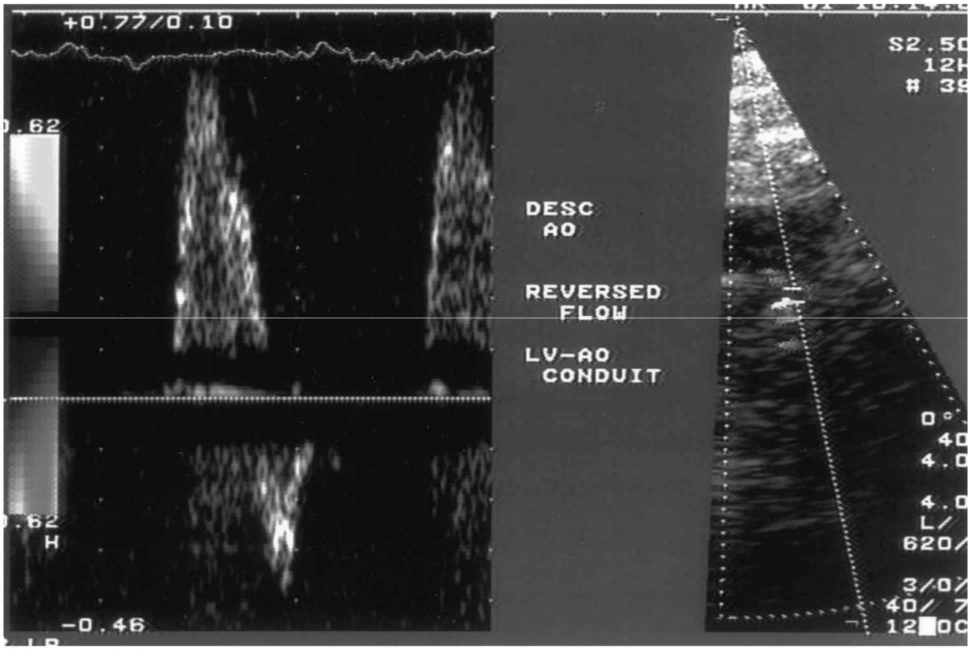

Figure 9. *TTE from the suprasternal notch demonstrates "reversed" systolic flow within the descending aorta, along with brief early diastolic flow reversal.*

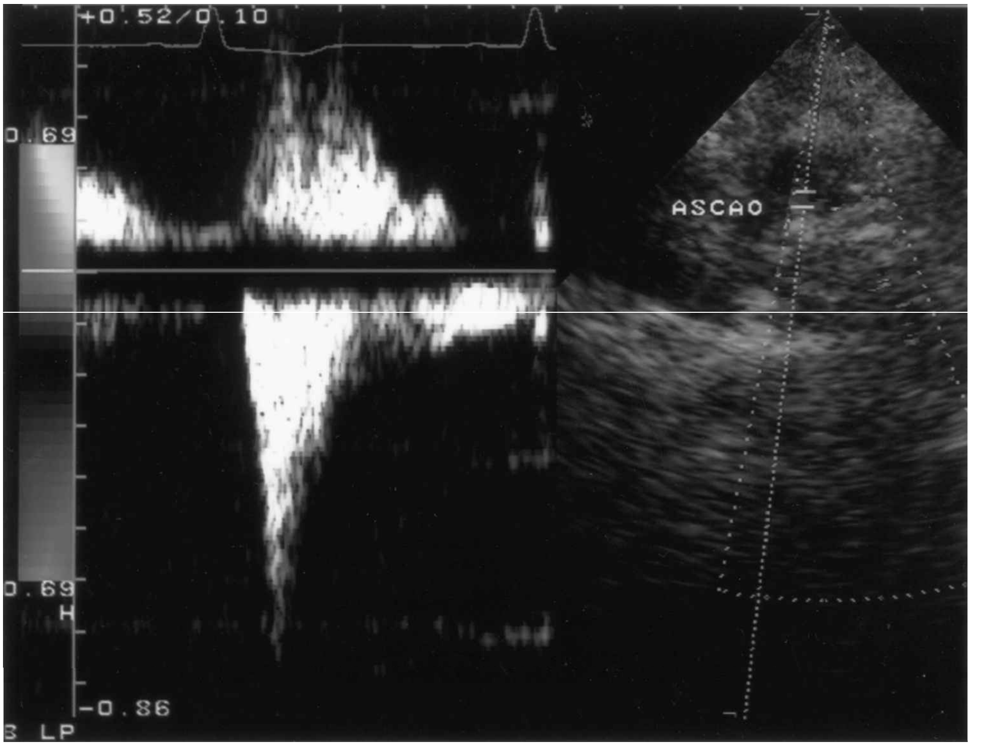

Figure 10. *TTE from the suprasternal notch demonstrates systolic flow towards the aortic root (away from transducer) from the ascending aorta.*

Direct imaging of the bioprosthetic valve was not possible in any patient by TTE or TEE. This may prove to be problematic in attempting to diagnose prosthetic valve infection. Doppler detection of a newly regurgitant bioprosthetic valve within the conduit, however, was possible.

Conclusion

Both TTE and TEE appear to be complementary in evaluation of an LVDA. Although neither TTE nor TEE could directly image the bioprosthetic valve within the conduit, normal laminar flow was documented within the conduit. Retrograde systolic flow within the thoracic aorta and early diastolic "reversed" flow in the thoracic aorta and distal conduit appear to be a "normal" finding.

Reference

1. Cooley DA, Lopez RM, Absi TS: Apicoaortic conduit for left ventricular outflow tract obstruction: Revisited. *Ann Thorac Surg* 2000;69:1511–1514.