

ECHO ROUNDS Section Editor: Edmund Kenneth Kerut, M.D. _____

Mitral Systolic Anterior Motion (SAM) with Dynamic Left Ventricular Outflow Obstruction Following Aortic Valve Replacement

Edmund Kenneth Kerut, M.D.,* Curtis Hanawalt, R.D.C.S.,† Marie Dearstine, R.D.C.S.,
‡ Robert Frank, M.D.,§ and Charles Everson, M.D.‡

*Heart Clinic of Louisiana, Marrero, Louisiana, Departments of Physiology and Pharmacology, LSU Health Sciences Center, New Orleans, Louisiana, †Cardiac and Vascular Imaging Center, West Jefferson Medical Center, Marrero, Louisiana, ‡Cardiology Department, Ochsner Westbank Medical Center, Gretna, Louisiana, and §Department of Surgery, West Jefferson Medical Center, Marrero, Louisiana

(*ECHOCARDIOGRAPHY, Volume 24, July 2007*)

SAM, dynamic obstruction, AVR

A 74-year-old male underwent aortic valve replacement (AVR) with a 21-mm Carpentier-Edwards Perimount aortic bioprosthesis (Edwards LifeSciences, Irvine, CA, USA) for symptomatic aortic valve stenosis (AS). Preoperatively, transthoracic echocardiography (TTE) revealed left ventricular hypertrophy (LVH) with a sigmoid shaped ventricular septum.^{1,2} By transesophageal echocardiography (TEE) the planimetered aortic valve area was 0.85 cm² (Fig. 1). Mitral chords appeared to be somewhat elongated or “redundant,” with noted systolic anterior motion of the mitral valve (SAM), but leaflets did not “touch” the interventricular septum nor cause a subaortic gradient (Fig. 2). However, because of the sigmoid septum and “redundant” chords, a myectomy was performed at the time of AVR. Histological evaluation of the myectomy specimen revealed myocardial hypertrophy, but myocyte disarray that is usually noted with hypertrophic cardiomyopathy (HCM), was not present.

Within 36 hours after surgery, the patient was noted to have a Grade III systolic murmur along the left sternal border as well as the

cardiac apex. TTE revealed SAM (Fig. 3) and dynamic LVOT obstruction having a peak gradient >64 mmHg with coexistent mitral regurgitation (Fig. 4).

The patient was treated with increased beta-blocker medications and liberalized fluids. The apical murmur disappeared, and the murmur

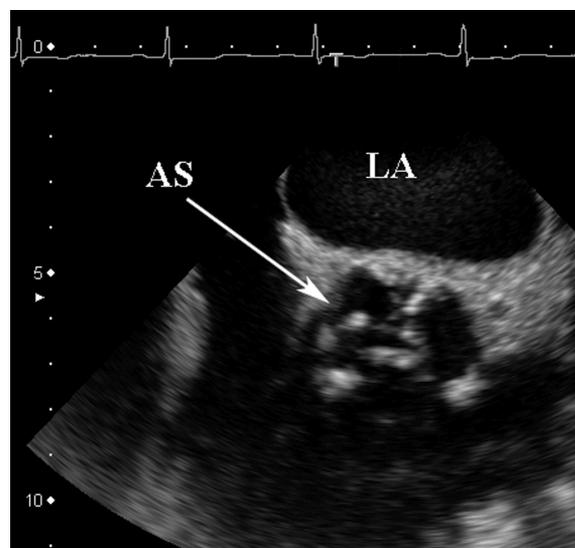


Figure 1. TEE in the mid-upper esophagus at 60°. The aortic valve was stenotic (AS) and planimetered to have a valve area of 0.85 cm². LA = left atrium.

Address for correspondence and reprints requests: Edmund Kenneth Kerut, M.D., 1111 Medical Center Blvd, Suite N613, Marrero, LA 70072. Fax: 504-349-6621; E-mail: kenkerut@pol.net

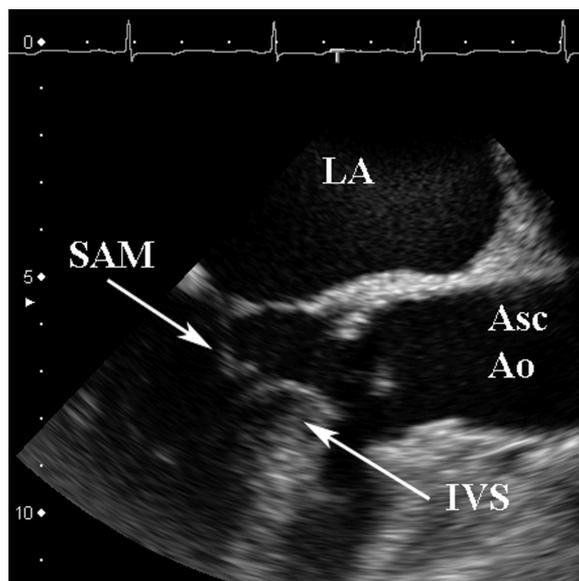


Figure 2. TEE in the mid-upper esophagus at 135°. Chordal elongation and SAM, which was not obstructive was noted. Asc Ao = proximal ascending aorta; IVS = interventricular septum; LA = left atrium.

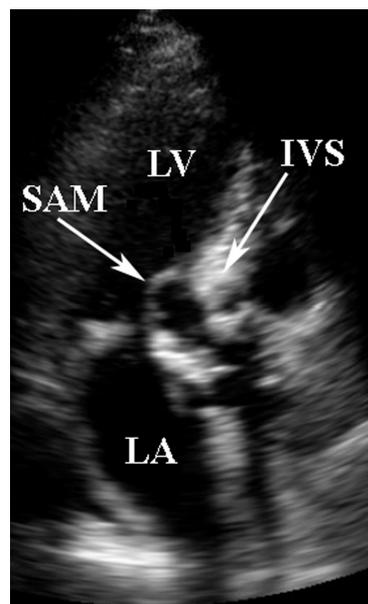


Figure 3. Postoperative apical five-chamber view demonstrates SAM of the mitral valve. IVS = interventricular septum; LA = left atrium; LV = left ventricle.

along the left sternal border decreased to Grade II. Flow acceleration through the LVOT was significantly reduced and the MR resolved. The patient was discharged home on the fourth postoperative day.

Although Doppler detected left ventricular (LV) intracavity gradients are a relatively common finding after AVR for AS,³⁻⁶ SAM with an associated LVOT gradient is a rather unusual occurrence.⁷⁻¹⁴ LV cavity obliteration with intracavity gradients (occurring below the level of the LVOT and not associated with SAM) may be noted in up to 14% of patients.⁵ However, in a series of 383 patients undergoing AVR for AS, in which TEEs were reviewed pre-, during, and postoperatively, not a single case of post-AVR SAM with LVOT dynamic obstruction was found.¹⁵

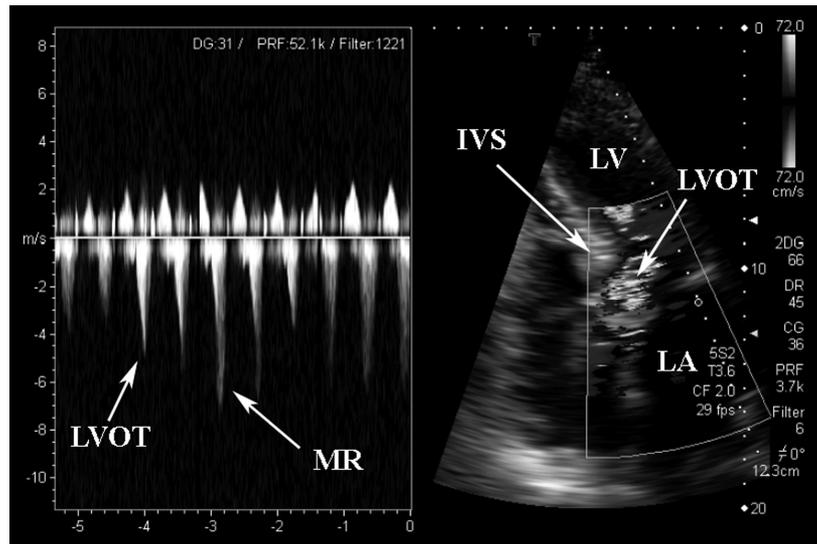
It is thought that the removal of a fixed obstruction will “unmask” dynamic obstruction, as LV end-systolic pressure falls.^{7,11} A patient may not have a concomitant HCM, but hypertrophy secondary to AS.¹³ In addition to AS, however, Nanda et al. reported postoperative SAM after AVR for aortic regurgitation.⁷ As mentioned earlier, our patient had a sigmoid-shaped septum and no evidence of HCM histologically.

It is important for the echocardiographer to be aware of this uncommon potential postoperative occurrence, as therapy requires fluids, beta-blocker therapy, and removal of inotropes.¹³ Phenylephrine has been used to “splint open the LVOT” in hemodynamically compromised patients.¹¹

It appears that “risk factors” for development of post-AVR SAM with dynamic LVOT obstruction include relative hypovolemia,^{11,12} inotropes, a small LV cavity,⁷ perioperative use of an intraaortic balloon pump,¹⁴ and structurally an abnormal mitral apparatus with elongated chordae, redundant mitral apparatus, and calcified mitral annulus.⁵ Also, it has been our observation that a relatively “small” LVOT— aortic annulus and LV septal hypertrophy (sigmoid septum) may be risk factors.

In conclusion, post-AVR SAM with dynamic LVOT obstruction is an uncommon finding, but one for which the echocardiographer should be aware. A patient with a suggestive murmur and possibly diminishing clinical status should raise one’s suspicion. Therapy includes fluids, beta-blockers, and removal of inotropes. Also, vasoconstrictors have been used in the acute setting when necessary, with resultant improved hemodynamics.

Figure 4. Postoperative apical five-chamber view with the continuous wave Doppler probe “sweeping” from the LVOT laterally to identify signals representing dynamic LVOT obstruction, and also mitral regurgitation (MR). The LVOT gradient was >64 mmHg. IVS = interventricular septum; LA = left atrium; LV = left ventricle.



References

1. Lever HM, Karam RF, Currie PJ, et al: Hypertrophic cardiomyopathy in the elderly: Directions from the young based on cardiac shape. *Circulation* 1989;79:580–589.
2. Prasad K, Atherton J, Smith GC, et al: Echocardiographic pitfalls in the diagnosis of hypertrophic cardiomyopathy. *Heart* 1999;82(Suppl. III):III8–III15.
3. Aurigemma G, Battista S, Orsinelli D, et al: Abnormal left ventricular intracavitary flow acceleration in patients undergoing aortic valve replacement for aortic stenosis: A marker for high postoperative morbidity and mortality. *Circulation* 1992;86:926–936.
4. Laurent M, Leborgne O, Clement C, et al: Systolic intra-cavitary gradients following aortic valve replacement: An echo-Doppler study. *Euro Heart J* 1991;12:1098–1106.
5. Bartunek J, Sys SU, Rodrigues AC, et al: Abnormal systolic intraventricular flow velocities after valve replacement for aortic stenosis: Mechanisms, predictive factors, and prognostic significance. *Circulation* 1996;93:712–719.
6. Gupta R, Sewani A, Ahmad M: Dynamic systolic left ventricular gradients: Differential diagnosis and management. *Echocardiography* 2006;23:168–171.
7. Nanda N, Gramiak R, Shah P, et al: Echocardiography in the diagnosis of idiopathic hypertrophic subaortic stenosis co-existing with aortic valve disease. *Circulation* 1974;50:752–757.
8. Block P, Powell W, Dinsmore R, et al: Coexistent fixed congenital and idiopathic hypertrophic subaortic stenosis. *Am J Cardiol* 1973;31:523–526.
9. Chung K, Manning J, Gramiak R: Echocardiography in coexisting hypertrophic subaortic stenosis and fixed left ventricular outflow obstruction. *Circulation* 1974;49:673–677.
10. Fox J, Glas K, Swaminathan M, et al: The impact of intraoperative echocardiography on clinical outcomes following adult cardiac surgery. *Sem Cardiothorac Vasc Anesth* 2005;9:25–40.
11. Routledge T, Nashef SAM: Severe mitral systolic anterior motion complicating aortic valve replacement. *Interactive Cardiovasc Thorac Surg* 2005;4:486–487.
12. Rosenhek R, Binder T: Monitoring of invasive procedures—The role of echocardiography in cathlab and operating room. *J Clin Basic Cardiol* 2002;5:139–143.
13. Schwinger ME, O'Brien F, Freedberg RS, et al: Dynamic left ventricular outflow obstruction after aortic valve replacement: A Doppler echocardiographic study. *J Am Soc Echocardiogr* 1990;3:205–208.
14. Morewood GH, Weiss SJ: Intra-aortic balloon pump associated with dynamic left ventricular outflow tract obstruction after valve replacement for aortic stenosis. *J Am Soc Echocardiogr* 2000;13:229–231.
15. Nowrangi SK, Connolly HM, Freeman WK, et al: Impact of intraoperative transesophageal echocardiography among patients undergoing aortic valve replacement for aortic stenosis. *J Am Soc Echocardiogr* 2001;14:863–866.