

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

Microbubbles in the Left Ventricle Associated with Mechanical Aortic Valve Regurgitation Signifies Valvular (Not Peri-Valvular) Regurgitation

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A 67-year-old female presented with progressive dyspnea. Physical examination was significant for a wide pulse pressure and a murmur of aortic regurgitation. Five years earlier, she received a bileaflet mechanical aortic valve prosthesis (St. Jude) for symptomatic aortic stenosis.

Two-dimensional echocardiography revealed findings of severe prosthetic valve regurgitation (Fig. 1, movie clip S1). In addition, bright echoes, consistent with microbubbles (MBs), were noted within the left ventricle (LV) during diastole (Fig. 2, movie clips S2 and S3).

The patient underwent aortic valve replacement, receiving a porcine prosthesis. At the time of surgery, it was evident that pannus ingrowth had partially obstructed 1 leaflet resulting in incomplete closure of that leaflet. The prosthetic annulus was normal with no evidence of a perivalvular leak. Postoperatively, the new porcine valve functioned normally, and the MBs seen preoperatively, were no longer present.

Microbubbles noted in the LV have been attributed to mechanical heart valves, predominantly in the mitral position.^{1–3} These MBs have not been reported to occur with tissue valves. Two different processes may produce so-called gas MBs. The first, which is termed cavitation, is vaporization of blood by a localized rapid pressure drop at the site of closure of the prosthetic ring and leaflet.^{4,5} This is a short-lived occurrence, and is not detected by echocardiography or Doppler. Degassing, a second process of MB formation, occurs by separation of gas from within a liquid. With a transient localized drop in pressure at the site of prosthetic valve closure, gas bubbles are formed, and then redissolve in

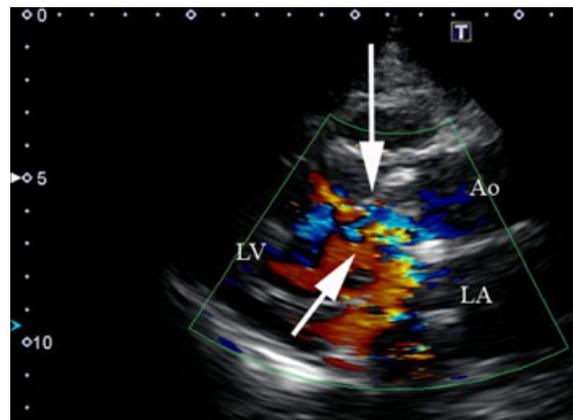


Figure 1. Diastolic frame with color Doppler in the parasternal long-axis view demonstrates color turbulence of aortic regurgitation (arrows). Ao = aorta; LA = left atrium; LV = left ventricle.

normal pressures of the cardiac chambers. It is this process of degassing that is felt to be the etiology of MB formation detected by echocardiography.^{1,5} Several authors report that these MBs are relatively long-lived, and are detected by transcranial Doppler (TCD). It has been the experience in our laboratory, that when MBs are seen within the LV cavity, they are generally not detected by TCD, suggesting that MBs redissolve back into blood relatively quickly.

It is reported that when MBs are found in association with a mechanical aortic valve prosthesis, they will be noted only within the upper left ventricular outflow tract (LVOT), in close proximity to the mechanical valve. This is thought to be a normal phenomenon and of no consequence.^{6,7} This patient's MBs noted deep within the LV cavity are presumably related to mechanical valvular regurgitation. It is logical that the valvular regurgitation "washed" the MBs back into the body of the LV. As the process of

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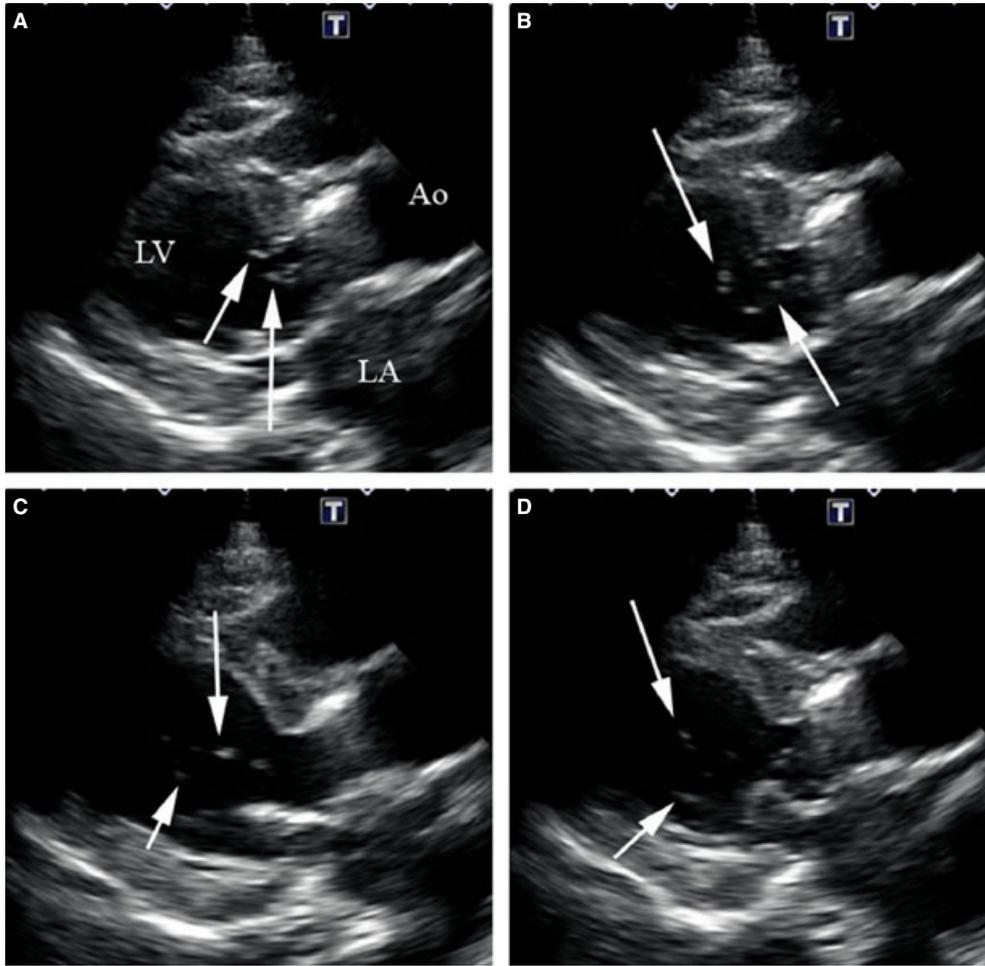


Figure 2. A-D. Four sequential diastolic frames in the parasternal long-axis view demonstrate microbubbles (arrows) within the cavity of the LV. Ao = aorta; LA = left atrium; LV = left ventricle.

degassing with MB formation occurs at the site of valve coaptation with the valve ring, presumably MBs would not “wash” back into the LV cavity with a perivalvular regurgitant jet.

In conclusion, the appearance of MBs related to mechanical heart valves is the result of the phenomenon of degassing, with resultant relatively short-lived MBs. In the experience of our laboratory, MBs are usually not detected by TCD.

When MBs are detected deep within the cavity of the LV, they are usually associated with mechanical mitral valves, and usually do not reflect any mitral prosthetic valve abnormality. In this case, MBs were noted deep within the LV cavity in a patient with a mechanical aortic valve prosthesis. This patient had incomplete closure of 1 leaflet, due to pannus ingrowth, with resultant valvular regurgitation. Presumably, the regurgitant jet “washed” the MBs back into the LV cavity. Thus, when MBs are seen deep within the LV cavity, in a patient with a mechanical aortic valve

prosthesis and associated aortic regurgitation, it may be a sign of valvular, and not peri-valvular, prosthetic aortic valve regurgitation.

References

1. Girod G, Jaussi A, Rosset C, et al: Cavitation versus degassing: In vitro study of the microbubble phenomenon observed during echocardiography in patients with mechanical prosthetic cardiac valves. *Echocardiography* 2002;19 Part 1: 531–536.
2. Labbe L, Roudaut R, Lorient-Roudaut MF, et al: Relationship between intravascular hemolysis and bright sparkling echoes detected by TEE in the vicinity of mechanical mitral prosthesis. *Echocardiography* 1996;13:381–386.
3. Kaymaz C, Ozkan M, Ozdemir N, et al: Spontaneous echocardiographic microbubbles associated with prosthetic mitral valves: Mechanistic insights from thrombolytic treatment results. *J Am Soc Echocardiogr* 2002;15: 323–327.
4. Graf T, Reul H, Detlefs C, et al: Causes of formation of cavitation in mechanical heart valves. *J Heart Valve Dis* 1994;3 (Suppl 1):S49–S64.
5. Richard G, Beaven A: Cavitation threshold ranking and erosion characteristics of heart valve prosthesis. (Abstract)

Jt Congress of IXth ISAO and XXth ESAO. Amsterdam: The Netherlands. 1993;17: 572.

6. Lerche CJ, Haugan KJ, Reimers JJ, et al: A misinterpreted case of aorta prosthesis endocarditis: Remember the phenomenon of microbubbles. *Echocardiography* 2013;E1–E5.
7. Arias RS, Pinero-Urbe I, Carreras F, et al: Misleading echocardiographic diagnosis of a prosthetic heart valve vegetation due to the cavitation phenomenon. *Exp Clin Cardiol* 2009;14:53–55.

Supporting Information

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

Movie clip S1. Apical long-axis with color Doppler demonstrates not only diastolic mitral inflow but a red diastolic jet of aortic regurgitation.

Movie clip S2. Apical long-axis imaging demonstrates microbubbles deep within the left ventricular cavity during diastole.

Movie clip S3. Parasternal long-axis imaging demonstrates microbubbles within the left ventricular cavity during diastole.