Assessment of the Transvalvular Pressure Gradient in Aortic Stenosis

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Bae et al describe the use of a pressure wire in conjunction with a 5–6 Fr guiding catheter to measure transvalvular gradients in 18 patients with aortic stenosis.[1] The method is clearly technically feasible, and correlated well with echocardiographic estimates of aortic valve area. The quality of the pressure tracings using the pressure wire method is excellent, and is reminiscent of the high-fidelity tracings recorded from multisensor electromagnetic tansducer-tipped catheters.

Challenges in the assessment of aortic stenosis severity. Correlation of echocardiography with invasive transaortic valve pressure gradients have been validated with correlation coefficients between 0.8 and 0.9. This study finds an *r*-value of 0.86 versus echocardiographic aortic valve area, and an *r*-value of 0.74 versus echocardiographic pressure gradients. It is curious that the greater *r* is with the less direct comparison with valve area, since the pressure wire measure is a direct assessment of gradient, and the confounding variable of thermal cardiac output compared to echocardiographic outflow measurements should make aortic valve area the less well-matched comparator. Thermal cardiac outputs have so much variability that they represent a weak, if not a weaker, link in the Gorlin formula for approximation of aortic valve area, which is already based on numerous assumptions and fraught with its own difficulties.[2] Ultimately, the quality of all of the data points involved in the calculation of aortic valve area is critically important.[3]

Technique for use of the pressure wire in aortic stenosis. This report describes a multipurpose guiding catheter and the figure shows the pressure wire in the left ventricle (LV), without any curve on the wire.[4–5] Prior descriptions of this pressure wire method used 4–6 Fr diagnostic catheters rather than guides. The use of diagnostic catheters allows for a greater variety of shapes to direct the wire across the valve. The potential for arterial access problems is further minimized by 4 Fr diagnostic catheters, and still provide adequate profile for the pressure wire.

The 0.014 inch pressure wire tends to be ejected from the LV when passed into the LV without a curve. It is particularly frustrating if the wire is ejected during the maneuver of pulling the catheter back into the aorta while trying to leave the pressure wire in the LV. The pressure wire can be shaped with curves to impart greater stability in the ventricle and diminish the possibility of systole "blowing" the wire out of the LV. I like to make a 1 cm radius "J" on the tip, and a 45–60° bend 3–4 cm proximal to the tip so the wire will sit in the inferior LV wall.[4]

Is there a best method to measure pressure gradient? A variety of approaches for measurement of the transaortic pressure gradient have been championed.[6] All of the existing methods have limitations. The authors assert that the pressure wire method does not pose the risks associated with transseptal puncture or a second arterial puncture. Some of the virtues of the pressure wire technique can now be found in 6 Fr double-lumen pigtail or multipurpose catheters. The newer versions are not prone to damping of the smaller lumen.

There are other important risks with retrograde catheterization. The most bothersome is noted in the study by Omran et al, who compared pre- and post-catheterization brain magnetic resonance imaging (MRI) scans and neurologic exams in 152 aortic stenosis patients undergoing diagnostic catheterization.[7] Patients were randomized to coronary study only versus retrograde catheterization of the LV for gradient and valve area assessment. Of those undergoing retrograde catheterization of the aortic valve, 22% had new focal diffusion-imaging abnormalities in a pattern consistent with acute cerebral embolic events after the procedure; 3% had clinically apparent neurological deficits. None of the patients without passage across the valve had evidence of cerebral embolism as assessed by MRI.

Table 1. Methods of measuring gradient.

Method	Ease of Use	Disadvantages
Pullback	+++++	Least accurate
Femoral sheath	+++++	Damping, pressure amplification, iliac stenosis
Long arterial sheath	++++	Damping, clots
Double arterial puncture	+++	Extra access risk
Double lumen pigtail	+++++	Damping in older versions
Transspetal	++	Not uniformly available, risk, expense
Pressure wire	+++	

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While retrograde catheterization remains the most common route, the Omran et al study suggests that transseptal access to the LV should still be considered as an option.[8] It is possible to record simultaneous LV and central aortic pressures via transseptal puncture without peripheral arterial access. A 7 Fr balloon flotation catheter can be passed antegrade from the left atrium into the LV through the Mullins sheath, and then looped in the LV apex and passed antegrade across the aortic valve. The Mullins can then be tracked into the LV over the balloon catheter, with resultant transvenous simultaneous LV and aortic root pressures. This method has gained some increased use as antegrade approaches to aortic valvuloplasty and percutaneous aortic valve replacement have recently developed.[9]

Table 1 shows the various methods for gradient measurement with their strengths and weaknesses. The method matters least when the clinical picture is clear and the gradient is large. The demands for better than a LV-sheath or pullback assessment are especially great in cases where the valve area is borderline, the gradient low, or the clinical picture ambiguous. As long as there is some debate about the best approach it can be concluded that there isn't one "best" that stands out.

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