Commentary: The right heart—a neglected sibling missing optimal closure

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Central Message

Bioprosthetic valves manufactured for the aortic position work well as pulmonary replacements. The lower transvalve pressure across pulmonary valves has implications for valve competence and sizing.

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If the left and right ventricles were siblings, the right would have a reasonable claim that the left receives preferential treatment during childhood treatment of congenital heart disease. This would be relevant to pathologies such as tetralogy of Fallot, truncus arteriosus, and pulmonary atresia with ventricular septal defect. By the time adolescence rolls around, the right ventricle has suffered years of volume and pressure load. The left ventricle remains perky, worried that its sick sibling might one day affect its longer-term prospects.¹ The ultimate indignity for the right may come when the surgeon implants a bioprosthesis designed specifically for the left side, a hand-me-down that might not be the best fit.

Pragt and colleagues² demonstrate that a prosthesis designed for the aortic position behaves quite differently in the pulmonary position. The excellent video clips starkly illustrate 2 things:

First, a Carpentier Edwards Perimount Magna Ease valve (Irvine, Calif) in the aortic position opens quickly and closes completely, in contrast to the slower opening and incomplete closure in the pulmonary position. The resulting regurgitant volumes are unlikely to be clinically important. Although statistically significantly different in the 21-mm valve versus the 25-mm valve, regurgitant volume is small (<5%) and essentially the same in the pulmonary versus aortic position at usual pressures.

Second, there is restriction of leaflet mobility inherent to this valve design. Unlike the normal semilunar valve, in bioprostheses there are no sinuses into which valve leaflets can move away from the column of ejected blood. During systole, the leaflets continue to move when in the open position, somewhat irregularly and possibly as a result of resonance, reflecting their individual material properties. It is not clear the extent to which this occurs in vivo versus in this particular model. Nevertheless, such movement may well have an impact has on leaflet durability.

The analytics in this article reminds us that effective orifice area is a function of transvalvar pressure difference, not simply the area of valve inflow. In clinical practice, most scenarios allow oversizing of pulmonary valve replacements. This study shows that larger valves tend to leak more, comparing 25- with 21-mm valves, and so it becomes a trade-off between a larger effective orifice area and greater regurgitation. If the assumption is that larger valves will last a longer time before being obstructive and the regurgitant volume is small, then no change in practice is likely.

The study is timely, given the trend toward earlier pulmonary valve replacement with a view to preserving right ventricular function.³ The effectiveness of this strategy remains limited by the quality of available valve replacements. Although our current metric of success is reintervention-free survival,⁴ we have a very poor handle on the proportion of time between valve replacements that an individual has satisfactory valve performance. Clinical thresholds for replacement are variable, subjective, and often surrogates of right ventricular work.

The value of this study extends beyond the initial observations to engineering concepts that relate incomplete valve closure to accelerated structural deterioration. For now, these are speculation, but further studies will inform the design of better prostheses. Although aortic prostheses in the pulmonary position are fine for the time being, the neglected sibling might well do better with a tailored solution.

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