Ventricular function in tetralogy of Fallot: A waste of energy

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The energy of the mind (heart) is the essence of life.

—Aristotle

Cardiac magnetic resonance has remained the gold standard technique to evaluate ventricular function in tetralogy of Fallot (TOF). However, it is largely based on ejection fraction, which does not quantify ventricular contractility. Investigators worldwide have been in search of the holy grail of right ventricular function assessment in TOF, a measure that could accurately anticipate overt failure (easily identified by ejection fraction) to better estimate the best timing for pulmonary valve replacement to preserve or salvage the ventricle.

Francois and colleagues¹ conducted a carefully designed study in 10 patients with repaired TOF and 9 healthy volunteers using kinetic ventricular energy (KE) as a potential biomarker of declining ventricular efficiency. They used the ratio of pulmonary or aortic valve flow to KE as a surrogate of ventricular-vascular coupling. The study demonstrated higher KE in the right ventricular outflow tract both in systole and diastole, a significant difference from healthy controls, where highest KE in diastole is along the inner curvature of the right ventricle, indicating that there is more “wasted” energy in patients with TOF. Perhaps not a surprising finding in TOF but certainly worth reporting. Interestingly, the peak systolic KE for the left ventricle was also higher in the TOF group, confirming once again the ventricular-ventricular interaction in this disease. The higher KE resulted in a lower main pulmonary artery or aortic flow to KE ratio, indicating that ventricular-vascular efficiency is diminished in a TOF heart. The concept of measuring KE is quite interesting and has been described before.²⁻⁴ However, it comes as no

surprise that KE or the flow to KE ratios were not associated with ventricular size and ejection fraction. We, and others have not been able to find a noninvasive measure that correlates well with ejection fraction in TOF. It is possible that global and regional strain will be the measure that will inform about ventricular contractility, but further study is still necessary.

Although KE does represent greater wasted energy in TOF—and it could provide some evidence of ventricular dysfunction as suggested by the authors—it is not a surrogate of ventricular contractility. It might become useful in the longitudinal follow-up, although further investigation is needed to validate this particular technique in a larger TOF population.

Is it a waste of time to persevere trying to identify the ideal noninvasive measure of right ventricle function that is readily available, reproducible, accurate, and precedes overt ventricular dysfunction measured as ejection fraction? I will leave this question unanswered. The energy of the mind is the essence of life.

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