Echocardiography and right ventricular function: Validation of functional criteria compared to in-vivo and ex-vivo contractility parameters.

Centre Chirurgical Marie Lannelongue, Le Plessis-Robinson, France (1)
Inserm U999,Le Plessis-Robinson, France (2)
Inserm U967, Chatenay Malabry, France (3)
university hospital of Bicêtre, Le Kremlin-Bicêtre, France (4)

Introduction: Right ventricular (RV) dysfunction is a major determinant of long-term survival in congenital heart diseases. Early echocardiographic detection of RV failure is mandatory, but recent parameters need to be validated. Objectives were to: (1) validate standard and strain echocardiographic parameters for evaluation of RV systolic function, compared to hemodynamic parameters; (2) assess the accuracy of these parameters for early detection of RV failure.

Methods: Combined RV overload as observed in repaired tetralogy of Fallot was surgically reproduced in 2-month-old piglets (n=6). Age-matched piglets were used as controls (n=4). RV function was evaluated at baseline and 4 months of follow-up by standard and strain echocardiographic parameters, compared to hemodynamic (conductance catheter). Sarcomere shortening and calcium transients were recorded in RV isolated myocytes (IonOptix). Contractile reserve was assessed by in-vivo (dobutamine 5µg/kg) and ex-vivo (isoprenaline 100nM) β-adrenergic stimulation.

Results: 4 months after surgery, hemodynamic RV ejection fraction (FEVD) was significantly decreased (29.7% [26.2-34] vs 42.9% [40.7-48.6], p<0.01), and inotropic responses to dobutamine were attenuated (contractile reserve ∆Emax = 51% vs 193% for controls). On echocardiography FAC, TAPSE, S' peak and RV free wall longitudinal strain rate were significantly decreased and correlated with FEVD. Strain rate and S’ peak were correlated with ∆Emax (r=0.75 and 0.78, p<0.05). Isolated RV myocytes from operated animals exhibited hypertrophy, decreased sarcomere shortening peak in response to isoprenaline (∆L= 7.8 ± 2.8% vs 10.7 ± 2.9%, p<0.05), and increased spontaneous calcium waves suggesting perturbations of calcium homeostasis.

Conclusion: In this model, both standard and strain echocardiographic parameters allowed the detection of early impairments of RV function and cardiac reserve, which are associated with cardiac excitation-contraction coupling alterations.