Circulatory correlates: vascular impedance, resistance, and capacity

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Abstract

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At zero frequency, impedance is equivalent to resistance in the steady-flow state. The phase difference is the delay in phase angle between the pressure and flow harmonics, which is analogous to time delay in the time domain. When a particular pressure harmonic leads the flow harmonic, the phase angle is positive. Conversely, when the pressure harmonic lags behind the corresponding flow harmonic, the phase is negative. (Reproduced with permission from Nichols WW, Conti CR, Walker WE, Milnor WR: Input impedance of the systemic circulation in man. Circ Res 1977;40:451–458.) Characteristic impedance is the ratio of pulsatile pressure to pulsatile flow at a site where pressure and flow waves are not influenced by wave reflection. Pulmonary vascular resistance (PVR) is the current standard for evaluating reactivity in children with pulmonary arterial hypertension (PAH). However, PVR measures only the mean component of right ventricular afterload and neglects pulsatile effects. We recently developed and validated a method to measure pulmonary vascular input impedance, which revealed excellent correlation between the characteristic impedance value and PVR and suggested a correlation between higher-harmonic impedance values and pulmonary vascular stiffness. Objectives: To evaluate the effects of endothelin inhibitors (ERAs) on hemodynamic and functional parameters in patients post-Fontan procedure with high pulmonary vascular resistance (PVR). Methods: Among our cohort of patients with Fontan circulation, 8 children, 8 adolescents, and 8 adults had PVR \( \geq 2 \) WU·m. These patients were treated with ERAs (minors with bosentan, adults with macitentan) and reevaluated after 6 months. Pre- and posttreatment hemodynamic variables were assessed by cardiac catheterization. Functional capacity was evaluated by cardiopulmonary exercise testing (CPET). Our prim
resistance (PVR) is the current standard for evaluating reactivity in children with pulmonary arterial hypertension (PAH). However, PVR measures only the mean component of right ventricular afterload and neglects pulsatile effects. We recently developed and validated a method to measure pulmonary vascular input impedance, which revealed excellent correlation between the zero harmonic impedance value and PVR and suggested a correlation between higher-harmonic impedance values and pulmonary vascular stiffness. Objectives: To evaluate the effects of endothelin inhibitors (ERAs) on hemodynamic and functional parameters in patients post-Fontan procedure with high pulmonary vascular resistance (PVR). Methods: Among our cohort of patients with Fontan circulation, 8 children, 8 adolescents, and 8 adults had PVR ≥2 WU*m. These patients were treated with ERAs (minors with bosentan, adults with macitentan) and reevaluated after 6 months. Pre- and posttreatment hemodynamic variables were assessed by cardiac catheterization. Functional capacity was evaluated by cardiopulmonary exercise testing (CPET). Our prim