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Effect of inhaled nitric oxide on blood flow dynamics in patients after the Fontan procedure using standard CMR flow measurements

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Background: Invasive hemodynamic studies have shown that nitric oxide (NO), a selective pulmonary vasodilator, can lower pulmonary vascular resistance (PVR) in Fontan patients although calculation of blood flow can be inaccurate in these patients. The aim of the study was to detect changes in blood flow within the Fontan circulation after inhalation of NO using cardiovascular magnetic resonance (CMR).

Methods: 29 patients (mean age 12.7 ± 6.7 years) after the Fontan procedure underwent CMR as part of their routine clinical assessment. Standard 2-dimensional blood flow measurements were performed in the inferior vena cava (IVC), superior vena cava (SVC) and ascending aorta (Ao) before and after inhalation of 40 ppm NO for 8-10 minutes. Aortopulmonary collateral (APC) flow was calculated as $Ao - (SVC + IVC)$.

Results: Heart rate (83 ± 19 to 82 ± 18 bpm; $p=0.90$) and transcutaneous oxygen saturations (93 ± 5 to 94 ± 4 %; $p=0.65$) did not change under NO inhalation. NO inhalation did not affect flow in the Ao (3.23 ± 0.72 to 3.07 ± 0.81 l/min/m²; $p=0.43$), IVC (1.56 ± 0.41 to 1.64 ± 0.47 l/min/m²; $p=0.50$) and SVC (1.03 ± 0.41 to 1.04 ± 0.42 l/min/m²; $p=0.88$) resulting in unchanged total caval flow (2.59 ± 0.62 to 2.69 ± 0.72 l/min/m²; $p=0.50$). APC flow decreased significantly from 0.64 ± 0.48 to 0.39 ± 0.45 l/min/m² ($p=0.04$).

Conclusions: Inhalation of NO does not improve pulmonary blood flow in Fontan patients while APC flow decreased significantly suggesting a beneficial effect of pulmonary vasodilators in unloading the single ventricle.