

## INCREASED CENTRAL VENOUS PRESSURE IS ASSOCIATED WITH IMPAIRED AND WORSENING RENAL FUNCTION IN CHILDREN WITH CARDIOVASCULAR DISEASE

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**Background:** In patients with cardiovascular disease, low cardiac output has been considered the primary hemodynamic determinant of renal injury. However, growing evidence in adults identifies increased central venous pressure (CVP) as the main driver. We hypothesized that in children with heart disease, higher CVP is associated with lower estimated glomerular filtration rate (eGFR), worsening renal function (WRF), and risk of mechanical circulatory support (MCS), heart transplant, or death.

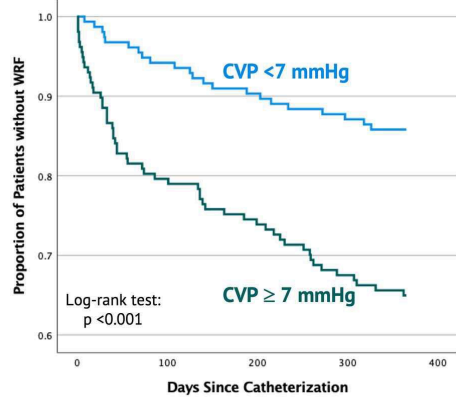
**Materials/Methods:** This is a single center cohort study of patients age 3 months to 21 years who underwent cardiac catheterization (cath) from 2009-2017; each patient's first cath was included. Those with intracardiac shunting, single ventricle anatomy, chronic kidney disease, inotropes or vasopressors, or MCS were excluded. A creatinine increase of at least 0.3 mg/dL within the year after cath defined WRF. Age, sex, height, weight, prior transplant, contrast volume by weight, superior vena cava pressure (CVP), cardiac index calculated by the Fick principle, arterial-venous oxygen saturation (AVO<sub>2</sub>) difference, B-type natriuretic peptide (BNP), right or left ventricular dysfunction, and tricuspid regurgitation were included in univariable analyses of eGFR within 72 hours prior to cath, WRF, and the composite outcome of MCS, transplant, or death within a year after cath. Variables with a p-value <0.1 were included in multivariable linear and Cox regression models.

**Results:** Of 312 patients, 77 (24.7%) developed WRF and 36 (11.5%) experienced the composite outcome. In adjusted analyses of baseline renal function, higher CVP ( $\beta$ =-2.44; 95% CI -3.35 to -1.54; p<0.001) was the only variable independently associated with eGFR. CVP (aHR 1.09; 95% CI 1.04 to 1.14; p<0.001) and AVO<sub>2</sub> difference (aHR 1.04; 95% CI 1.01 to 1.08; p=0.01) were the only independent risk factors for WRF. Receiver operating curves identified 7mmHg as the best cutoff to predict WRF, and CVP  $\geq$ 7mmHg (aHR=2.60; 95% CI 1.55 to 4.36; p<0.001) was indeed associated with WRF. Similarly, CVP (aHR=1.10; 95% CI 1.01 to 1.19; p=0.03), AVO<sub>2</sub> difference (aHR 1.10; 95% CI 1.04 to 1.16; p<0.001), right ventricular dysfunction (aHR=2.44; 95% CI 1.12 to 5.32; p=0.02), and, in a separate model, CVP  $\geq$ 7mmHg (aHR=8.49; 95% CI 1.47 to 49.01; p=0.02) predicted MCS, transplant, or death.

**Conclusions:** Among kids with cardiovascular disease, higher CVP is associated with lower baseline renal function and higher risk of declining renal function over time, independent of cardiac index.

**Images / Graph / Table**

Survival without Worsening Renal Function



Survival without Mechanical Circulatory Support, Heart Transplant, or Death

