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Non-invasive Cardiac Output Monitoring during Catheter Interventions in Patients with Cavo-pulmonary Circulations

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Introduction:
Electrical velocimetry uses changes in thoracic electrical bio-impedance to calculate cardiac output non-invasively. Bioimpedance is altered with systolic acceleration of erythrocytes in the aorta and can be used to calculate several indices related to cardiac output. Recent studies have favourably compared electrical velocimetry to previously established invasive measurements of cardiac output including thermodilution and transoesophageal Doppler. Electrical velocimetry has also been shown to be comparable to cardiac output measured using the Fick principle in children with complex congenital heart disease.

Methods:
We used an Icon® monitor (Osypka, Germany) to assess changes in CO during catheter interventions in ten patients with cavo-pulmonary connections. Nine patients had hypoplastic left heart syndrome post fenestrated Fontan and one had pulmonary atresia, intact ventricular septum and Glenn shunt (1.5 ventricle repair). Stroke volume was recorded during periods of stable heart rate before and after interventions and so was directly related to CO. Mean patient age was 6.1 (4.8-15.3) years and mean weight was 18.5 (15-63) kilograms.

Results:
Stroke volume and therefore cardiac output were increased in patients following stenting the left pulmonary artery (mean 16% increase). Partial occlusion and complete closure of right to left atrial shunts showed a decrease in stroke volume which may reflect a reduction in ventricular preload (mean 12% decrease). Creation of Fontan stent fenestration resulted in a marked increase in stroke volume (22% and 29% increase) in these two patients.

Conclusions:
Icon® is a novel monitoring technique ideally suited for use during interventional catheter procedures. Initial experience in patients with Glenn shunt and Fontan circulations is promising and provides new insights into the pathophysiology of the circulation in series.