The impact of pulmonary artery size on early outcomes after non-fenestrated Fontan operation

Objective
While adequate pulmonary artery index (PAI) is a well-known requirement for total cavopulmonary connection (TCPC), clinical effects and lower limit of PAI are unclear. The change of PAI after bidirectional cavopulmonary shunt (BCPS) may be affected by hemodynamic factors before BCPS. We sought to identify the impact of PAI on the early outcomes after non-fenestrated TCPC and associated factors for change in PAI following BCPS.

Methods
The medical charts of consecutive patients who underwent non-fenestrated TCPC preceded by BCPS between 2009 and 2021 were reviewed. Nakata index before each palliation was calculated and used for PAI. First, the impact of PAI on occurrence of chylothorax and length of ICU stay after TCPC was determined. Second, the associated factors for change of PAI ((PAI before TCPC)-(PAI before BCPS)) were evaluated. In the second analysis, patients with interventions for pulmonary stenosis at or after BCPS were excluded.

Results
A total of 221 patients were included. The primary diagnosis was hypoplastic left heart syndrome in 88 patients, unbalanced atrioventricular septal defect in 22, tricuspid atresia in 28, double inlet left ventricle in 31 and others in 49. The BCPS and TCPC were performed at a median age of 4.1(3.1-5.9) months and 2.0(1.7-2.4) years, respectively. The PAI was median 162(121-233) mm2/m2 before BCPS and 163(131-209) mm2/m2 before TCPC. After TCPC, chylothorax occurred in 48 patients (22%) and median ICU stay was 6(4-8) days. In logistic regression analysis, the PAI before BCPS (OR 0.99, p=0.01) and TCPC (OR 0.99, p=0.007) were significant risk factors for chylothorax, while mean pulmonary artery (PA) pressure was not. In receiving operating curve analysis using Youden's index, the cut-off value for PAI before TCPC was 161 mm2/m2. In Cox regression analysis, the PAI before BCPS (HR 1.001, p=0.043) and TCPC (HR 1.003, p=0.005) were significantly associated with length of ICU stay. The change of PAI was median 2.8(-46 to 33) mm2/m2 and significantly associated with mean PA pressure before BCPS in linear regression analysis (Coefficient B -2.7, p=0.008) and correlation analysis (r= -0.21, p= 0.009). (Figure)

Conclusion
Small PAI before TCPC and BCPS are significant risk factors for occurrence of chylothorax and long ICU stay after non-fenestrated TCPC. The cut off value for PAI before TCPC was 161 mm2/m2 with regard to occurrence of chylothorax. Mean PA pressure before BCPS is associated with change in PAI after BCPS.