

The importance of right atrium tension in patients after atriopulmonary Fontan procedure

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Introduction: Elevated venous pressure is thought to play a pivotal role in the development of characteristic complications such as liver fibrosis/dysfunction, arrhythmias, protein-losing enteropathy and thrombosis after Fontan surgery, particularly that for the atriopulmonary connection (APC). On the other hand, there are many patients who have dilated RA after APC-Fontan. We hypothesized that the right atrial tension (RAtension) rather than RA pressure (RAp) is important for the progression of these complications after APC-Fontan.

Methods: We studied 51 consecutive APC-Fontan patients who underwent cardiac catheterization (median postoperative period; 14 years). We calculated the RAtension from RAp and RAradius to be counted backward by RAvolume (RAv) assuming that RA as a sphere according to Laplace's law

[tension (dyne/cm) = transmural pressure (dyne/cm²:Central Venous Pressure (mmHg)×1333) × radius (cm:3√(3×volume (cm³) / 4π)) / 2] . RAv was calculated by a biplane Simpson's method using RA-graphy. We investigated the correlation between the hemodynamic data by their cardiac catheterization (RAtension, RAp, RAradius, Qs, Rp, EDP and EDV) and the complications of APC-Fontan

Results: Out of 51 patients after APC-Fontan, 27 patients had these complications (Liver fibrosis; 23, arrhythmias; 2, protein-losing enteropathy; 1 and thrombosis; 1). Age and postoperative period were not correlated with these complications. Among the hemodynamic data, only the RAtension and RAradius were significantly correlated with these complications (P=0.02 and P=0.03). In this study, cut-off level of RAtension for presence of Fontan complications was 23,050 dyne/cm by receiver operating characteristic curve (sensitivity; 81.4% and false positive rate; 33.3%). Moreover, it was very interesting result that the RAtension was most strongly correlated with log [BNP (brain natriuretic peptide)] (r=0.438) among the hemodynamic data.

Conclusion: The present results indicate the importance of RAtension rather than high venous pressure for the development of post-Fontan complication and elevation of BNP. However, we should pay attention that even a little elevation of RAp caused by exercise increase the RAtension on a large scale under the circumstance of RA dilation according to Laplace's law.