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Editorial

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Pulmonary Arterial Elastance and Right Ventricle-Pulmonary Artery Coupling in Postoperative Tetralogy of Fallot Patients

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▸ See the article "Impact of Pulmonary Arterial Elastance on Right Ventricular Mechanics and Exercise Capacity in Repaired Tetralogy of Fallot" in volume 53 on page 406.

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The evaluation of predicting factors of outcomes after tetralogy of Fallot (TOF) repair and the assessment of proper timing of pulmonary valve replacement (PVR) is crucial in pediatric cardiology. In postoperative TOF patients, the main complications are right ventricle (RV) dilation, dysfunction, or arrhythmia caused by RV outflow tract obstruction or pulmonary insufficiency. RV volume, function, or QRS duration on ECG have been suggested as predictors of the timing of PVR and postoperative outcome. In addition to these parameters, pulmonary arterial elastance (Ea) and RV and pulmonary artery (RV-PA) coupling have been suggested as potential factors to predict the outcome of postoperative TOF patients. At this point, Kim et al.'s study[1] would be significant.

Ea indicates arterial stiffness and is measured by RV afterload. In the evaluation of Ea made among patients with pulmonary hypertension due to left heart disease, high Ea could predict mortality over pulmonary vascular resistance and the transpulmonary gradient,[2] and be correlated with exercise intolerance.[3]

Marked histologic abnormalities of the pulmonary artery in postoperative TOF patients are demonstrated, and Ea as a potential outcome predictor was also suggested by several studies.[4-6] High Ea was related to reduced RV ejection and RV enlargement in Inuzuka et al.'s study.[5] It is consistent regarding RV volume and function as the poor outcome predictors. Egbe et al.[6] also reported high Ea in the postoperative TOF group and the effect on exercise intolerance. In this study, TOF patients had higher Ea compared to normal control, and it was negatively associated with peak oxygen consumption suggesting pulmonary vascular dysfunction may contribute to exercise intolerance in this disease group.

Kim et al.[1] also evaluated the significance of Ea in postoperative TOF patients. They classified TOF patients according to the level of Ea and compared pre-and postoperative hemodynamic data. High Ea group had low exercise capacity, similar to Egbe et al.'s study,[6] but had less pulmonary regurgitation and both ventricular volumes, contrary to Inuzuka et al.'s study.[5] In addition, Ea could not predict the optimal surgical outcome. However, compared to Egbe et al.'s study,[6] Ea of TOF patients in Kim et al.'s study[1] was relatively lower (low Ea group 0.3±0.1, high Ea group 0.5±0.2 mmHg/mL/m^2 in Kim et al.'s study[1] vs. TOF group 0.64±0.12, normal group 0.48±0.08 mmHg/mL/m^2 in Egbe et al.'s study[6]). In addition, age was younger

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(not appeared, age at PVR 21.9 [19.4–27.5], vs. 33±13 year), and fewer patients had prior palliative shunt (0.04% vs. 41%), which may contribute to the difference of results.

On the other hand, RV-PA coupling on RV function in postoperative TOF patients has also been under evaluation. In addition to RV dysfunction caused by residual pulmonary valve regurgitation leading to ventricular dilation and ventricular failure, a highly compliant low-pressure pulmonary artery known as RV-PA coupling has emerged as a significant contributing factor to the outcome. RV-PA coupling is defined as Ea/RV end-systolic elastance ratio (Ea/Emax). Typically, Ea/Emax ratio is around 0.5, and above 1.0, known as uncoupling, is considered ineffective mechanical work production.[7] Sandeep et al.[8][9] reported two third of postoperative and 80% of transannular patch-repaired patients had RV-PA uncoupling. The increased Ea/Emax ratio could be a marker to identify the progress of RV dysfunction and the optimal timing of PVR in postoperative TOF patients. Panaioli et al.[10] also reported worse RV-PA coupling could be an indicator for PVR despite normal RV systolic function.

In Kim's study,[1] RV-PA coupling was not different between low and high Ea groups. However, it was one of the risk factors for suboptimal outcomes along with preoperative RV end-diastolic and systolic volumes in the univariate analysis, even though it was not significant in the multivariate analysis.

Based on these findings, Ea and RV-PA coupling as predictors of postoperative risk factors in postoperative TOF patients are still controversial but of practical value. Further evaluation in a large number of patients and long-term evaluation are needed.

REFERENCES

1. Kim SJ, Li MH, Noh CI, Kim SH, Lee CH, Yoon JK. Impact of pulmonary arterial elastance on right ventricular mechanics and exercise capacity in repaired tetralogy of Fallot. *Korean Circ J* 2023;53:406-17.
CROSSREF
2. Tampakakis E, Shah SJ, Borlaug BA, et al. Pulmonary effective arterial elastance as a measure of right ventricular afterload and its prognostic value in pulmonary hypertension due to left heart disease. *Circ Heart Fail* 2018;11:e004436.
PUBMED | CROSSREF
3. Gorter TM, Obokata M, Reddy YN, Melenovsky V, Borlaug BA. Exercise unmasks distinct pathophysiologic features in heart failure with preserved ejection fraction and pulmonary vascular disease. *Eur Heart J* 2018;39:2825-35.
PUBMED | CROSSREF
4. Bédard E, McCarthy KP, Dimopoulos K, Giannakoulas G, Gatzoulis MA, Ho SY. Structural abnormalities of the pulmonary trunk in tetralogy of Fallot and potential clinical implications: a morphological study. *J Am Coll Cardiol* 2009;54:1883-90.
PUBMED | CROSSREF
5. Inuzuka R, Seki M, Sugimoto M, Saiki H, Masutani S, Senzaki H. Pulmonary arterial wall stiffness and its impact on right ventricular afterload in patients with repaired tetralogy of Fallot. *Ann Thorac Surg* 2013;96:1435-41.
PUBMED | CROSSREF
6. Egbe AC, Anavekar NS, Connolly HM. Abnormal pulmonary arterial elastance is associated with reduced exercise capacity in tetralogy of Fallot. *J Am Heart Assoc* 2019;8:e011731.
PUBMED | CROSSREF
7. Sanz J, García-Alvarez A, Fernández-Friera L, et al. Right ventriculo-arterial coupling in pulmonary hypertension: a magnetic resonance study. *Heart* 2012;98:238-43.
PUBMED | CROSSREF

8. Sandeep B, Cheng H, Luo L, et al. Assessing right ventricle pulmonary artery coupling and uncoupling using echocardiography and cardiopulmonary exercise test in post operative TOF patients. *Curr Probl Cardiol*. 2022 [Epub ahead of print].
PUBMED | CROSSREF
9. Sandeep B, Huang X, Li Y, et al. Evaluation of right ventricle pulmonary artery coupling on right ventricular function in post operative tetralogy of Fallot patients underwent for pulmonary valve replacement. *J Cardiothorac Surg* 2020;15:241.
PUBMED | CROSSREF
10. Panaioli E, Birritella L, Graziani F, et al. Right ventricle-pulmonary artery coupling in repaired tetralogy of Fallot with pulmonary regurgitation: Clinical implications. *Arch Cardiovasc Dis* 2022;115:67-77.
PUBMED | CROSSREF