

# Influence of Outflow Tract Reconstruction on Long-Term Right Ventricular Function and Pulmonary Regurgitation after Repair of Tetralogy of Fallot: A Clinical Magnetic Resonance Imaging Study

C-A. Chen<sup>1</sup>, J-K. Wang<sup>2</sup>, M-H. Wu<sup>2</sup>, M-Y. Su<sup>3,4</sup>, H-Y. Yu<sup>5</sup>, C-I. Chang<sup>5</sup>, I-S. Chiu<sup>5</sup>, I-S. Chen<sup>5</sup>, and W-Y. I. Tseng<sup>6</sup>

<sup>1</sup>Department of Pediatrics, National Taiwan University Hospital, Taipei, Taiwan, <sup>2</sup>Department of Pediatrics, National Taiwan University Hospital, <sup>3</sup>Institute of Biomedical Engineering, National Yang-Ming University, <sup>4</sup>Department of Medical Imaging, National Taiwan University Hospital, <sup>5</sup>Department of Surgery, National Taiwan University Hospital, <sup>6</sup>Center for Optoelectronic Biomedicine, College of Medicine, National Taiwan University

## Background

Surgical repair of tetralogy of Fallot (TOF), the most common cyanotic congenital heart disease, has achieved excellent early and medium-term outcomes. However, residual pulmonary regurgitation (PR) occurs almost inevitably after right ventricular outflow tract (RVOT) reconstruction and has been associated with late right ventricular (RV) dysfunction, limited exercise tolerance, and increased risk of ventricular arrhythmia. There are still controversies regarding the impacts of different types of RVOT reconstruction on postoperative PR severity and RV function. Studies about this issue are further hampered by limitations of traditional RV imaging modalities. The purpose of this study was to evaluate the influence of different types of RVOT reconstruction on long-term RV function and PR severity using cardiac magnetic resonance (CMR).

## Methods

A total of 91 (59 males) patients (aged  $19.2 \pm 8.9$  years,  $15.7 \pm 7.6$  years after total correction) were enrolled. Medical history and surgical notes were reviewed. The CMR study was performed under ECG-gating on 1.5-T MR system (Sonata, Siemens, Erlangen, Germany). A short-axis contiguous stack of steady-state free-precession cine images from the atrioventricular ring to the apex was quantified to determine the following measurements: RV end-diastolic volume index (RVEDVi), RV end-systolic volume index, and RV ejection fraction (RVEF). Phase-contrast gradient echo images were acquired with the imaging plane transecting the long axis of RVOT. The PR fraction was calculated according to the flow-time curve based on the phase-contrast data at RVOT.

## Results

Detailed surgical records about types of RVOT reconstruction were available in 85 patients: transannular patch (TAP) in 55 (65%), RVOT patch only in 22 (26%), and no patch (infundibulectomy/valvotomy) in 8 (9%). There were no differences in sex, age at total correction, previous shunt palliation, and QRS duration among these 3 groups. The PR fraction significantly increased in TAP group ( $35.0 \pm 15.0\%$ ) than in RVOT patch group ( $19.2 \pm 16.5\%$ ,  $P < 0.001$ ) and no patch group ( $11.3 \pm 13.5\%$ ,  $P < 0.001$ ). Patients with TAP had highest RVEDVi ( $128.9 \pm 38.1$  ml/m<sup>2</sup>) compared to RVOT patch group ( $106.9 \pm 24.9$  ml/m<sup>2</sup>,  $P = 0.04$ ) and no patch group ( $92.9 \pm 30.5$  ml/m<sup>2</sup>,  $P = 0.02$ ). TAP was also associated with higher incidence of RVOT aneurysm or akinesia (36%) compared to RVOT patch (14%) or no path (0%) ( $P = 0.008$ ). Despite a wide range of PR fraction and RVEDVi, most patients had preserved RVEF ( $50.0 \pm 9.5\%$ ) regardless of types of RVOT reconstruction. Subgroup analysis in TAP group with ( $n = 30$ ) or without ( $n = 25$ ) the insertion of autologous pericardial monocuspid valve revealed no difference in PR fraction ( $35.2 \pm 10.8\%$  vs.  $34.9 \pm 18.0\%$ ,  $P = \text{NS}$ ) and RVEDVi ( $119.5 \pm 24.0$  ml/m<sup>2</sup> vs.  $136.9 \pm 46.0$  ml/m<sup>2</sup>,  $P = \text{NS}$ ).

## Conclusions

The use of TAP during RVOT reconstruction was significantly associated with advanced degree of PR, increased extent of RV dilatation, and higher incidence of RVOT aneurysm or akinesia late after TOF correction. Pericardial monocuspid valve used for TAP failed to demonstrate long-term beneficial effect in the prevention of PR and RV dilatation.

## References

1. Davlouros PA, et al. *J Am Coll Cardiol* 2002;40:2044-52.
2. Norgard G, et al. *Circulation* 1996;94:3276-80.
3. Bigras JL, et al. *J Thorac Cardiovasc Surg* 1996;112:33-7.