Evaluation and Visualization of the Right Ventricle Using Three-Dimensional Echocardiography

28

Yui Ito, Yusaku Kamiya, Azuma Ikari, and Katsuaki Toyoshima

Keywords

Pulmonary hypertension · Three-dimensional echocardiography · Right ventricular function

As neonatal right ventricular (RV) function undergoes transition from fetal to neonatal circulation, evaluation of the neonatal right ventricle is important. We analyzed the RV function of three infants with persistent pulmonary hypertension of the newborn (PPHN) using three-dimensional transthoracic echocardiography (3D echo) and herein report the results.

Patient 1 was a boy born at 40 weeks (weight, 3284 g; Apgar score (Ap), 7/8) with neonatal asphyxia, meconium aspiration syndrome, and PPHN. His oxygen saturation increased with inhaled nitric oxide (iNO) therapy; 3D echo was performed 6 and 12 h after iNO therapy.

Patient 2 was a girl born at 41 weeks (weight, 3010 g; Ap, 1/6) with neonatal asphyxia, neonatal pneumonia, and PPHN. She underwent iNO therapy and improved; 3D echo was performed before and after iNO therapy.

Patient 3 was a boy with congenital cystic adenomatoid malformation and hydrops fetalis. He was born by cesarean section at 35 weeks with uncontrollable pleural fluid and ascites. His pulmonary hypertension (PH) and respiratory condition did not improve even after thoracentesis, lobectomy, and sildenafil. He died 27 h after birth. Echocardiography was performed after lobectomy.

In each case, we performed 3D echo with an EPIQ system and X7-2 transducer (Philips Healthcare, Amsterdam, Netherlands) and analyzed the images with a TomTec system (TomTec Imaging Systems, Unterschleißheim, Germany) (Fig. 28.1). 3D data were acquired in a full-volume data set from the four-chamber

Y. Ito (✉) · Y. Kamiya · A. Ikari · K. Toyoshima
Neonatology, Kanagawa Children's Medical Center, Yokohama, Kanagawa, Japan

T. Nakanishi et al. (eds.), *Molecular Mechanism of Congenital Heart Disease and Pulmonary Hypertension*, https://doi.org/10.1007/978-981-15-1185-1_28

Fig. 28.1 3D RV image by a TomTec System

CASE1

	iNO 6h	iNO 12h
RVEDV (ml)	5.7	5.7
RVSV (ml)	1.6	2.3
RVEF (%)	28	40

CASE2

	Before iNO	After iNO
RVEDV (ml)	5.1	4.9
RVSV (ml)	1.4	1.9
RVEF (%)	28	39

CASE3

	CPAM
RVEDV (ml)	4.8
RVSV (ml)	3.5
RVEF (%)	27

Fig. 28.2 Data of RVEDV, RVSV, RVEF in Cases 1–3

apical view. The frame rate was 50 Hz. In Patient 1, the right ventricular end-diastolic volume (RVEDV) was the same (5.7 ml) at 6 and 12 h after starting iNO therapy; however, the right ventricular stroke volume (RVSV) and right ventricular ejection fraction (RVEF) increased from 1.6 to 2.3 ml and from 28% to 40%, respectively. In Patient 2, the RVEDV slightly decreased from 5.1 to 4.9 ml before and after iNO therapy. The RVSV and RVEF increased from 1.4 to 1.9 ml and from 28% to 39%, respectively. In Patient 3, the RVEDV was 4.7 ml, RVSV was 3.5 ml, and RVEF was 27% (Fig. 28.2).

The RVEF increased in Patients 1 and 2 following the improvement of PH and remained low in Patient 3. This may suggest that RVEF is significantly correlated

with PH. Murata et al. [1] reported that RVEF measured by 3D echo could help to noninvasively predict the clinical outcomes of PH. Thus, 3D echo data might be useful for evaluating patients' cardiac condition and choosing treatment.

Reference

1. Murata M. Prognostic value of three-dimensional echocardiographic right ventricular ejection fraction in patients with pulmonary arterial hypertension. Oncotarget. 2016;7(52):86781–90. https://doi.org/10.18632/oncotarget.13505.