Left Ventricular End-Diastolic Dimension for the Assessment of the Pulmonary to Systemic Flow Ratio in Congenital Heart Diseases

Satoshi Masutani, MD

Ventricular septal defect (VSD) and patent ductus arteriosus (PDA) are the most common pediatric heart diseases, typically exhibiting an increase in pulmonary flow induced by a left-to-right shunt. Even with apparent heart failure (HF) symptoms in pediatric VSD or PDA induced by a large shunt, the normal myocardium with abnormal volume overload is in striking contrast to adult HF with reduced ejection fraction. Indications for surgical closure of pediatric VSD and PDA must be carefully determined based on various considerations. Among these, the pulmonary to systemic blood flow ratio (Qp/Qs) is an important index of disease severity, reflecting the shunt volume. Classically, cardiac catheterization can quantify Qp/Qs. However, as cardiac catheterization is an invasive procedure, establishing a noninvasive method for evaluating Qp/Qs is of clinical relevance.

As the left-to-right shunt of the VSD and PDA increases pulmonary flow, the elevated pulmonary venous return enters the left atrium and left ventricle (LV), unless a significant atrial septal defect is encountered; thus, the left heart size should reflect the shunt volume and Qp/Qs in such a situation. However, body size varies greatly in children. Therefore, the LV end-diastolic dimension (LVEDd) corrected by body size has been used as one of the echocardiographic indices reflecting the shunt volume in VSD and PDA, using the ratio of the measured LVEDd to the “normal” LVEDd estimated by body height or body surface area (BSA).

The opinions expressed in this article are not necessarily those of the editors or of the Japanese Circulation Society.

Received October 21, 2021; accepted October 22, 2021; J-STAGE Advance Publication released online November 23, 2021
Department of Pediatrics, Saitama Medical Center, Saitama Medical University, Kawagoe; Department of Pediatric Cardiology, International Medical Center, Saitama Medical University, Hidaka, Japan
Mailing address: Satoshi Masutani, MD, Department of Pediatrics, Saitama Medical Center, Saitama Medical University, Staff Office Building 110, 1981 Kamoda, Kawagoe 350-8550, Japan. E-mail: masutani@saitama-med.ac.jp
All rights are reserved to the Japanese Circulation Society. For permissions, please e-mail: cj@j-circ.or.jp
ISSN-1346-9843
surface area (BSA)\(^5\)–\(^11\) (% normal LVEDd). The LVEDd (calculated by body height) of 87% of preterm infants who underwent surgical ligation of PDA reportedly exceeded 130% of the normal.\(^3\) Although some studies have used % normal LVEDd,\(^5\) others used Z-scores for LVEDd.\(^5\)\(^11\)\(^12\) However, to date, no study has confirmed the potential relationship between any indexed LVEDd by body size and Qp/Qs by cardiac catheterization in this population. In this issue of the Journal, the study by Sumitomo et al\(^13\) resulted in a clinically relevant contribution because it indicated that the Z-score of the LV diameter strongly correlates with the Qp/Qs. The Z-score calculation was substantially complicated when compared with that of % normal LVEDd. The authors used the method described by Pettersen et al\(^11\) to calculate the expected LV diameters (Z=0, or 100% normal) using BSA and Z-score. Figure 2 shows the expected value curve of LVEDd by BSA, as reported by Pettersen et al\(^11\) and others.\(^5\)\(^10\) The line of Pettersen et al\(^11\) was found to lie between the regression lines of 2 oriental population studies of Aotsuka et al (Japan)\(^10\) and Wang et al (China),\(^5\) which are not markedly far apart. Thus, it appears reasonable to apply Pettersen’s method\(^11\) to the study by Sumitomo et al\(^13\) performed in Japan. As stated by the authors, the Z-score of LVEDd by Pettersen’s method, using a single value of mean square error,\(^11\) demonstrated a 1:1 relationship with % normal LVEDd (Figure 2). Moreover, these 2 parameters demonstrated an almost linear relationship in the physiological range of -2 to +4 SD. Thus, the clinical significance of the 2 indices is considered equal as long as a single value of mean square error is used;\(^11\) however, both concepts tend to differ, as the Z-score indicates how far apart in the population and % normal directly indicates how much the LV expands. Their results\(^13\) indicated that Qp/Qs=2 corresponds to a Z-score of LVEDd=3.25 and % normal LVEDd=138%. 

Even in this era of three-dimensional echocardiography, LVEDd, a classical and simple echocardiographic linear measurement, continues to play an important role in reflecting Qp/Qs in children with VSD and PDA, as shown by Sumitomo et al.\(^13\)

### Financial Disclosure

The author has no financial relationships relevant to this article to disclose.

### Conflict of Interest

The author has no conflicts of interest relevant to this article to disclose.

### References


