**Title: Interobserver Variability in Echocardiographic Assessment of Right Ventricular Function in Hypoplastic Left Heart Syndrome and Variants**

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**Background:** Objective assessment of single ventricular function by echocardiographic measurements is essential in patients with hypoplastic left heart syndrome (HLHS). These measurements have inherent interobserver variability. The objective of this study was to assess the degree of reproducibility in different echocardiographic measurements in HLHS.

**Methods:** Prospectively enrolled patients with HLHS underwent detailed transthoracic echocardiography (TTE). Two experienced sonographers reviewed the studies and made offline measurements on each study independently. Each measurement was taken in triplets and the average was used for statistical analysis. Interobserver variability and limits of agreement between the sonographers were determined. Bland-Altman plots were used to analyze the data.

**Results:** A total of 74 echocardiographic studies were reviewed. The mean differences and limits of agreement between two observers were calculated for tricuspid annular plane systolic excursion (TAPSE), right ventricular systolic and diastolic areas, right ventricular apical and short axis fractional area change (FAC), isovolumic acceleration (IVA), right ventricular myocardial performance index (MPI), tricuspid valve annular diameter, and tricuspid valve lateral annular systolic velocity (TVS’).

In our study, TAPSE and TV annulus diameter were the parameters that exhibited the greatest Intra class correlation (ICC) amongst all other RV parameters (> 0.81). Comparing the measurements of two sonographers, limits of agreement for TAPSE and TV annulus diameter were (-1.97, 1.47) and (-5.34, 3.59), respectively. TVS` and MPI also demonstrated substantial agreement. We found significant interobserver variability between measures of fractional RV area change as shown by the wide limits of agreement and low ICC. Table 1 shows the respective ICC with the corresponding 95% confidence interval of all the RV parameters measured in the study. It also shows the mean differences and limits of agreement between the two echocardiographic readings.

**Conclusions:** Although the mean differences between observers are minimal in most right ventricular parameters of size and function, the wide limits of agreement show significant interobserver variability in individual patients. These findings are consistent with previously published studies in other congenital heart diseases and highlight the importance of using multiple measurements to objectively assess right ventricular function especially in HLHS patients.

Table 1: The intra class correlation and mean difference between the echocardiographic readings of two observers.

| **Measurement** |  | **n** | **Mean** | **ICC (1,1)** | **95% LCL** | **95% UCL** | **Mean difference** | **SD** |  **Limits of Agreement\*** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| TV annulus diameter (mm) |  | 74 | 29.66 | 0.921 | 0.887 | 0.947 | -0.87 | 2.28 | (-5.34, 3.59) |
| Short Axis RV diastolic area (cm2) |  | 70 | 19.06 | 0.955 | 0.934 | 0.970 | -1.59 | 2.20 | (-5.91, 2.72) |
| Short Axis RV systolic area (cm2) |  | 70 | 11.18 | 0.948 | 0.924 | 0.966 | -0.83 | 1.97 | (-4.7, 3.03) |
| Short Axis RV FAC (%) |  | 70 | 43.35 | 0.712 | 0.608 | 0.798 | -1.11 | 6.58 | (-14.01, 11.78) |
| Apical RV diastolic area (cm2) |  | 73 | 22.76 | 0.954 | 0.933 | 0.969 | -1.17 | 2.53 | (-6.13, 3.78) |
| Apical RV systolic area (cm2) |  | 72 | 14.23 | 0.948 | 0.925 | 0.966 | -0.65 | 2.00 | (-4.56, 3.27) |
| Apical RV FAC (%) |  | 72 | 39.26 | 0.558 | 0.428 | 0.677 | -0.68 | 6.20 | (-12.83, 11.47) |
| TAPSE (mm) |  | 71 | 8.87 | 0.851 | 0.790 | 0.899 | -0.25 | 0.88 | (-1.97, 1.47) |
| Isovolumic Acceleration time  |  | 70 | 2.07 | 0.695 | 0.588 | 0.786 | -0.26 | 0.54 | (-1.32, 0.79) |
| RV MPI |  | 70 | 0.47 | 0.735 | 0.638 | 0.816 | 0.03 | 0.08 | (-0.14, 0.19) |
| Lateral TV annulus systolic velocity (cm/sec) |  | 71 | 0.06 | 0.756 | 0.664 | 0.830 | 0.01 | 0.01 | (-0.02, 0.02) |
| (Abbreviations: FAC; fractional area change, MPI; myocardial performance index, RV; right ventricle, TAPSE; tricuspid annular plane systolic excursion, TV; tricuspid valve)\*The range within which 95% of the differences would be expected to occur, calculated as the mean difference. |