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Perioperative assessment of left ventricular function by 2D strain (speckle tracking) in pediatric cardiac surgery

Perdreau E., Séguéla P.E., Jalal Z., Nelson-Véniard M., Mouton J.B., Guillet E., Mauriat P., Thambo J.B.
Service de Cardiologie Pédiatrique et Congénitale
Hôpital Cardiologique du Haut Lévèque - CHU de Bordeaux
Pessac, France

Introduction
Cardiopulmonary bypass can be responsible for post-operative left ventricular dysfunction. Conventional echocardiography parameters, such as left ventricular ejection fraction measured by Teicholz or Simpson methods, are neither accurate nor reproducible enough during this critical period. 2D strain by speckle tracking could be interesting in this context. The main objective of the study was to estimate the feasibility and reproducibility of 2D strain throughout the peri-operative period. The second objective was to assess the post-operative evolution of 2D strain values after surgical closure of atrial septal defect.
Methods
34 pediatric patients (<18 years) with congenital heart disease undergoing cardiac surgery with cardiopulmonary bypass were included in this prospective single center study. Daily echocardiography was performed from the day before the surgery until the fifth post-operative day. Left ventricular ejection fraction (Teicholz and Simpson methods) and 2D strain values (longitudinal, circumferential and radial) were measured.
Results
The mean age was 5 years [3,27-6,60] and the mean weight was 16 kg [11,56-21,28]. The mean cardiopulmonary bypass and aortic cross-clamping durations were respectively 109.6 minutes [82.9-136.3] and 54.3 minutes [40.5-68.1]. The global post-operative feasibility of longitudinal, circumferential and radial 2D strain was respectively 93%, 95% and 95% and was similar to the one of conventional parameters (97%). The intra-observer correlation coefficient of longitudinal, circumferential and radial strains were respectively 0.916 ($p<0.001$), 0.880 ($p<0.001$) and 0.701 ($p=0.002$). The inter-observer correlation coefficient of longitudinal, circumferential and radial strains were respectively 0.885 ($p<0.001$), 0.829 ($p<0.001$) and 0.559 ($p=0.020$). In the cohort, 13 patients had surgical closure of atrial septal defect. Circumferential 2D strain was significantly improved for these patients (-15.07 [-17.37;-12.76] versus -19.86 [-22.73;-17.00], $p=0.028$).
Conclusions
2D strain is feasible and reproducible for the assessment of left ventricular function after surgery for congenital heart disease. The reproducibility of this method is higher than the one of conventional parameters. Circumferential 2D strain significantly improves after atrial septal defect surgical closure. Further studies are needed to assess the clinical interest of this technique, especially for early diagnosis of post-operative myocardial dysfunction, and to determine the expected evolution of 2D strain values for each congenital heart disease.