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EDITORIAL

Strain Measurements in Perioperative Settings

Recent interest in strain has led to use of this emerging technology for perioperative purpose. Speckle tracking echocardiography (tissue tracking, two-dimensional strain, three-dimensional strain, and strain rate) shows a promise not only to monitor myocardial function but also prognosticate the outcomes in both cardiac surgery and noncardiac surgery. Encouraging reports from all over the world in use of these parameters as prediction tool have led to a new era in echocardiography—"the strain era".

Strain means regional myocardial deformation. The rate at which this change occurs is called strain rate.[1] Myocardial deformation of left ventricular (LV) could be in multiple dimensions simultaneously *viz* lengthening, shortening, or thickening. Therefore, myocardial regional motion as measured by strain is divided into four types namely longitudinal, radial, circumferential, and rotational.[2] There are two ways to measure LV strain; by tissue doppler imaging (TDI) and speckle tracking (2D or 3D). Although there are certain limitations of TDI strain, they can be a valuable noninvasive tool for routine clinical use in certain specific scenarios. Kumar et al[3] in first of its kind study have very meticulously tried to compare the TDI strain and the speckle tracking strain. Although speckle tracking is more convenient and a robust measure of LV strain but in conditions where, it is difficult to view the entire wall of LV, GLS becomes difficult to compute. Therefore, in such conditions, TDI strain can act as surrogate for LV strain.

Left Ventricular systolic function is a strong predictor of outcomes in both cardiac and noncardiac surgeries. The most common echocardiographic measure of left atrial LV function *viz* left ventricular ejection fraction (LVEF) has several important limitations. Still we continue to use this, as no robust parameter has been able to replace it till date. Assessment of myocardial deformation requires consideration of both strain (especially longitudinal strain), which correlates with LVEF, and strain rate (speed of deformation), which correlates with rate of rise of left ventricular pressure (dP/dt). Recently, there has been interest in circumferential strain wherein it is shown that circumferential strain improves with early LV dysfunction (decrease LVEF and GLS) to a point where the damage is irreversible and the circumferential strain also starts decreasing.[4]

Apart from LV strain, this parameter has really expanded its application to other chambers. Right ventricular (RV) and LA strains have come up in many ways in assessing subclinical dysfunction of RV[5] or predicting postsurgery atrial fibrillation. RV strain in pediatric surgery is yet to be explored and needs to be validated. Negi et al[6] in his study has studied right ventricular strain pattern in cohort of TOF patients undergoing intracardiac repair and has found decrease in strain immediate postoperative which recovered at 3 months. This study illustrates the use of strain to follow outcomes and suggests that strain may be a cheaper surrogate for cardiac magnetic resonance imaging in this population for assessing the RV in limited resource settings. However, the use of strain in perioperative setting and its ability to predict postoperative outcome in different age groups and surgeries need to be studied.

The biggest limitation at this stage for the strain to replace LVEF as a marker for LV systolic function is the vendor variability. There is small but clinically significant variation among vendors and it should be considered in performing serial studies. There should be a continuous and collective effort for ongoing standardization in assessing this parameter.

Myocardial deformation in any perspective depends upon the interaction between myocardial loading conditions and its contractility. Therefore, to think that strain is a load independent index will be foolhardy. Because acute changes in load occur during surgery, serial echocardiographic examinations performed intraoperatively should take changes in heart rate, preload, and afterload into consideration. Further studies are needed to validate the effect of change in loading conditions on the value of strain.

Three-dimensional speckle-tracking technology has been introduced for transthoracic echocardiography, but is not yet available for transesophageal echocardiography. This technology remains limited by a low frame rate and poor temporal resolution. Further research in this field will only open new avenues and more applicability of this parameter.

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