Inter-rater reliability of contractility when measured with MR dp/dt.

Introduction

Assessment of contractility is of clinical significance given its load and length independent properties that are responsible for the development of force (inotropy), and velocity (clinotropy).(1) Contractility when surveyed with TEE or calculated from an arterial waveform often impacts clinical decision making. Contractility is not a static consideration. Hemodynamic factors including ejection fraction, afterload, preload, and heart rate all contribute dynamic variables when assessing overall cardiac performance.(2,3) Contractility is the change in peak isovolumetric force (isovolumic pressure) at a given end diastolic volume. There are several ways to assess contractility, including ESPVR (the relationship of contractility to the effect of preload on LV end-systolic pressure), ejection fraction, myocardial strain, and the maximum rate of change in the left ventricular pressure during isovolumetric contraction measured by TEE (LV dP/dt estimated using the MR velocity spectrum). (4) The purpose of this study was to assess the inter-rater reliability among three different groups of users (medical students, anesthesiology residents, and TEE-certified anesthesiologists) measuring already captured TEE mitral regurgitant jet doppler images. These findings are significant given the importance of interpreting measurements that can change the management of critically ill patients.

Methods

This is a prospective observational cohort study that includes 33 echo images that surveyed dp/dt that were acquired and stored using Phillips Epiq CVx TEE 7.0.8. Images were selected to include a diverse sample of flow patterns from data that was originally collected under the IRB approved protocol: Comparison of Arterial Pressure Waveform Derived dp/dt Versus Transesophageal Echocardiogram Derived Left Ventricular dp/dt Max in the intra-operative setting (ClinicalTrials.gov: Identifier: NCT04726852). Echo images were measured by one of three groups: medical students, anesthesia residents, and TEE-certified anesthesiologists, utilizing the automated echo tools to calculate the slope, dp/dt. Measurements were performed utilizing two points (100 and 300 cm/s) from the continuous-wave Doppler spectrum of the MR jet, recorded on a data collection sheet and collated utilizing Microsoft Excel data sheets that were then imported onto Recal for Ordinal, Interval and Ratio Data(https://dfreelon.org/utils/recalfront/recal-oir/). Data was then analyzed with Krippendorff's alpha for interval data.

Results

Data collection sample sizes: medical students (n= 17), residents (n=17), attending anesthesiologists (n=17). Because of the multiple raters and nominal data, inter-rater reliability was evaluated with Krippendorf's alpha reliability estimate. Krippendorf's alpha for all evaluators was .46. Krippendorf's alpha for medical students was .504, anesthesia residents .457, and for attending anesthesiologists, .387, suggesting a moderate degree of agreement both within and amongst the groups.

Conclusions

The measurements of dp/dt across groups were mostly in agreement with one another. This is clinically significant because it suggests the clinical utility and appreciable reproducibility to survey TEE dp/dt measurements. Given the clinical significance of contractility in assessing global cardiac function, it's an important factor to survey and be able to readily reproduce given its implication to change clinical decisions including inotropic support or volume administration. Our findings show that agreement didn't necessarily improve with technical expertise as might be expected. Historically, image acquisition and interpretation required special expertise or certification, but as software continues to improve there may potentially be more widespread use by users across training levels. Furthermore, our findings of moderate agreement may be secondary to the observation that small differences in the selected measurement points can result in large differences in the final dp/dt calculation. This is a limitation that needs to be considered when utilizing dp/dt as a measurement to guide clinical decision making and further highlights the importance of considering all the hemodynamic factors when assessing peri-operative cardiac function.

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