



## Research Brief

# Are objective measures of tricuspid annular motion and velocity used as frequently as recommended by current guidelines? A pilot study



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## ABSTRACT

In this retrospective study 420 echocardiograms from a single center were reviewed showing that TAPSE was acquired in 66% while TA TDI s' signals were recorded in 98% of all echocardiograms. Based on these results greater efforts are required to standardize acquisition and reporting of objective measurements of RV function.

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## 1. Research letter

Adverse clinical outcomes are seen with both subclinical right ventricular (RV) dysfunction and with frank RV systolic dysfunction.<sup>1</sup> Though several imaging tools are currently available, echocardiography still remains as the most commonly used first line diagnostic modality.<sup>1–3</sup> Unfortunately, most echocardiographic results report subjective RV interpretations.<sup>1</sup> Therefore, incorporation of well-validated and reproducible objective measures of RV systolic function such as tricuspid annular plane systolic excursion (TAPSE) and tricuspid annular tissue Doppler imaging systolic velocity (TA TDI s') into day-to-day clinical practice should standardize reporting of echocardiographic findings.<sup>1</sup>

Even though cardiac magnetic resonance imaging has become the gold standard for RV size and systolic function assessments<sup>2</sup>; lack of widespread availability of this imaging modality precludes its use in all studies and echocardiography still remains the most used first line of imaging.<sup>3</sup> TAPSE and TA TDI s' are still recommended for routine use in the echocardiographic assessment of RV systolic function as being the most reproducible

measurements when compared to cardiac magnetic resonance imaging.<sup>1–3</sup>

Since our laboratory has been instrumental in developing these echocardiographic surrogate measures of RV systolic function assessment,<sup>4–6</sup> and we have implemented at our institution a RV-specific echo driven protocol performed by trained and certified sonographers, we have now designed a pilot study to examine how often both of these TA measures are acquired on routine studies.

For this retrospective study, all echocardiograms performed at University Hospital, Cincinnati, OH from June 15, 2014 to July 15, 2014 were reviewed. This study included both inpatients and outpatients. The University of Cincinnati IRB approved this study (Protocol number 12061302).

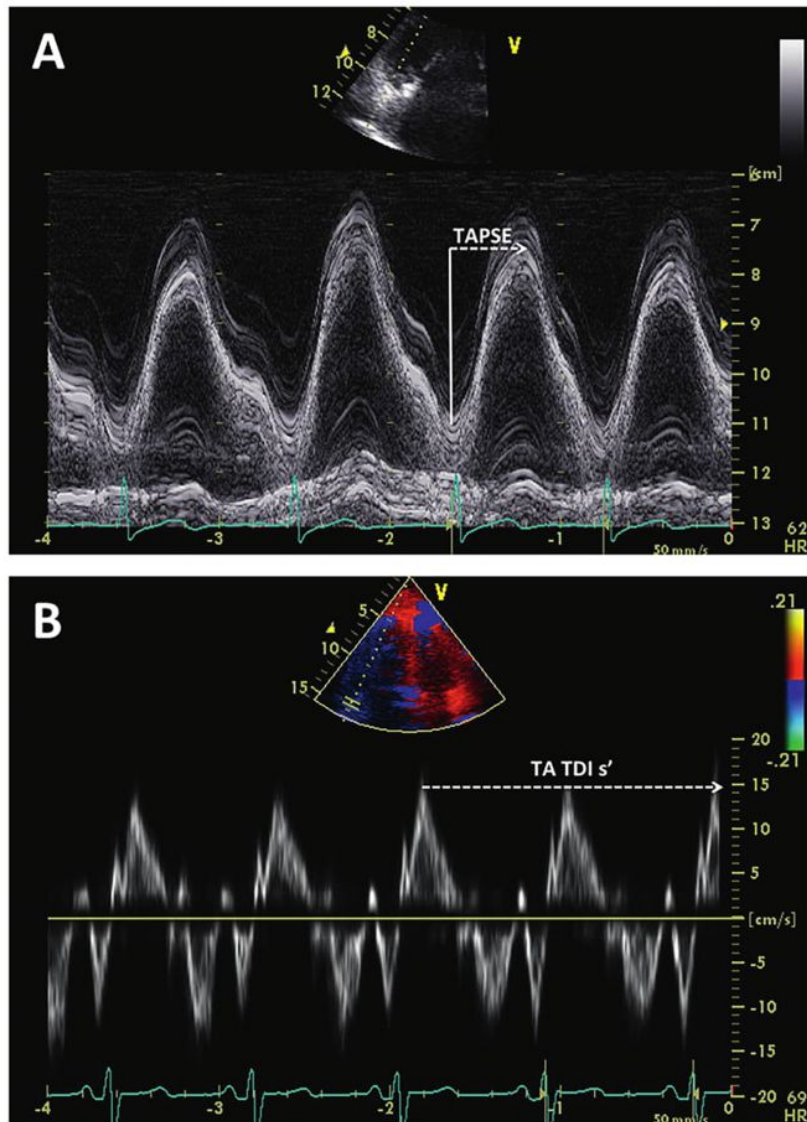
Only echocardiograms of patients in normal sinus rhythm without tachycardia, presence of ectopic or paced beats were included; while studies from patients with breast implants, recent chest wall or abdominal surgery were excluded as well as limited follow up studies, those performed by a fellow in training off regular hours and specific RV echo driven protocol studies.

Two-dimensional echocardiographic studies were performed on GE Medical Systems (Milwaukee, WI, USA) following published guidelines.<sup>1</sup> Offline analysis of all measurements was made using Merge Cardio Workstation software.

A representative normal M-mode TAPSE recording demonstrating proper measurement is shown in Fig. 1A while a

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**Fig. 1.** (A) Representative normal M-mode TAPSE recording with line and arrow demonstrating proper measurement. (B) Representative normal TA TDI s' Doppler signal with corresponding proper measurement.

representative normal TA TDI s' Doppler signal is shown in Fig. 1B also demonstrating correct measurement.

Continuous data is presented as mean  $\pm$  standard deviation and measurements were compared using two-tailed unpaired *t*-test assuming unequal variances. Linear regression analysis was used to examine the relationship between the studied dependent variables. All statistics were calculated using the MedCalc Software bvba Version 14.12.0 (Belgium). A  $p < 0.05$  was considered significant.

A total of 420 echocardiograms met all inclusion and none of the exclusion criteria and represent roughly 80% of the usual study load at our institution. Mean age was  $55 \pm 16$  years, 51% were males, with a mean body surface area of  $2.0 \pm 0.3$  cm<sup>2</sup>.

Most common requests for obtaining echocardiographic examination in our studied cohort included evaluation of left ventricular systolic function (48%), wall motion assessment (15%), shortness of breath (15%), chest pain (10%), murmur (8%) and palpitations (4%).

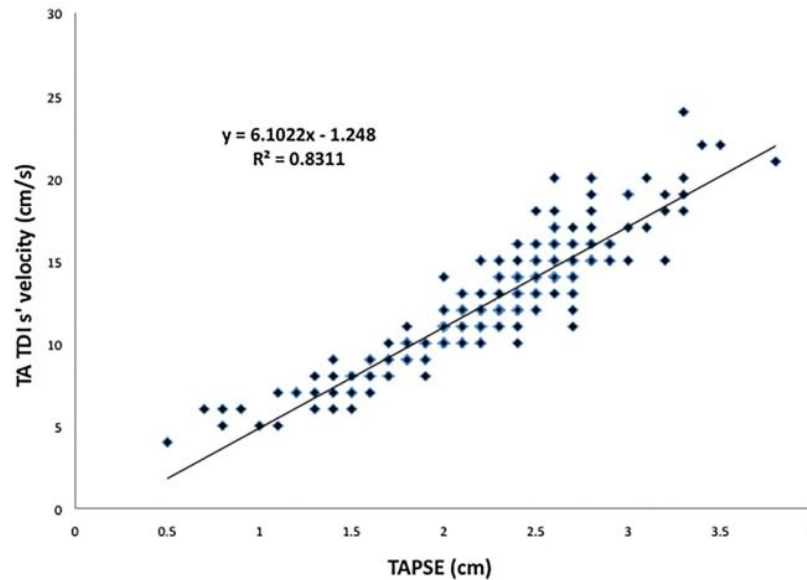
TA TDI s signals were acquired in 405 (96%) studies while TAPSE was only acquired in 278 (66%) echocardiograms. Furthermore,

both echocardiographic measures were obtained in 271 (65%) studies while in 15 (4%) studies none of these objective measures were acquired.

The overall strength of the correlation between TAPSE and TA TDI s' when both of these measures were acquired in our studied population are shown in Fig. 2.

The results of this pilot study shows, for the first time, that TAPSE and TA TDI s' measurements are not acquired with the same frequency and consistency on routine echocardiographic studies even in a laboratory that is required to obtain such measurements on a daily basis based on institutional protocols.

The following limitations need to be acknowledged. First, the retrospective nature of the study and the small sample size analyzed. However, the main goal to determine was accomplished. Second, patients with cardiac rhythms besides normal sinus rhythm were not included. However, our intention was to examine if these objective measures were recorded and the presence of any other rhythm besides normal sinus would have precluded this analysis using echocardiography. Third, speckle tracking imaging data was not included. Unfortunately, speckle tracking though



**Fig. 2.** Line graph showing the strong correlation noted between TAPSE and TA TDI s' for this study population. Only patients that had both measures were used for this analysis.

more accurate assessments can be made using this technique; this advanced imaging modality is not widely available.

Greater efforts are required to standardize acquisition and reporting of both qualitative and quantitative parameters to increase accuracy of RV function assessment. Though this pilot study was not intended to explain these observed differences, in our experience M-mode interrogation is more technically demanding than TDI.<sup>4–7</sup> The latter is likely due to differences in the acquisition between TAPSE M-mode and TA TDI s' Doppler signals. Specifically, M-mode interrogation is usually more demanding, as it requires proper adjustment of the baseline to get proper amplitude of the annular motion measurements. Furthermore, there is need for a good imaging window in order to avoid artifacts caused by either the RV free wall or tricuspid valve chordae reflections that might affect proper TAPSE measurement. In contrast, TA TDI s' signals are generally least technical difficulty and provide a distinctive a clear signal.

In summary, echocardiography is the most commonly used first-line imaging modality to examine RV function.<sup>1–3</sup> Even though a variety of different measures have been proposed to assess RV function<sup>1</sup>; TAPSE and TA TDI s' offer the least user dependent and most reproducible measures than can be routinely acquired and provide immediate useful information.

### Conflicts

No conflicts of interest reported from any of the authors for this work.

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### References

- Rudski LG, Lai WW, Afilalo J, et al. Guidelines for the echocardiographic assessment of the right heart in adults: a report from the American Society of Echocardiography endorsed by the European Association of Echocardiography, a registered branch of the European Society of Cardiology, and the Canadian Society of Echocardiography. *J Am Soc Echocardiogr.* 2010;23(July(7)):685–713.
- van der Zwaan HB, Geleijnse ML, McGhie JS, et al. Right ventricular quantification in clinical practice: two-dimensional vs. three-dimensional echocardiography compared with cardiac magnetic resonance imaging. *Eur J Echocardiogr.* 2011;12(September(9)):656–664.
- Valsangiacomo Buechel ER, Mertens LL. Imaging the right heart: the use of integrated multimodality imaging. *Eur Heart J.* 2012;33(8):949–960.
- López-Candales A, Dohi K, Iliescu A, Peterson RC, Edelman K, Bazaz R. An abnormal right ventricular apical angle is indicative of global right ventricular impairment. *Echocardiography.* 2006;23(May(5)):361–368.
- Saxena N, Rajagopalan N, Edelman K, López-Candales A. Tricuspid annular systolic velocity: a useful measurement in determining right ventricular systolic function regardless of pulmonary artery pressures. *Echocardiography.* 2006;23:750–755.
- López-Candales A, Dohi K, Rajagopalan N, Edelman K, Gulyasy B, Bazaz R. Defining normal variables of right ventricular size and function in pulmonary hypertension: an echocardiographic study. *Postgrad Med J.* 2008;84:40–45.
- Vargas PE, Lopez-Candales A. Essential echocardiographic evaluation in patients with suspected pulmonary hypertension: an overview for the practicing physician. *Postgrad Med.* 2015;30(November):1–15.