

In Patients With Right Bundle Branch Block, ECG Z-Axis QRS-T Voltage-Time-Integral Predicts Right Ventricular Structure And Function



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Background

- Right bundle branch block (RBBB) is the most common His-Purkinje conduction abnormalities resulting in alteration of right ventricular depolarization.
- RBBB prevalence ~17% by age 80 y (1).
- It is unclear if there are any quantitative ECG differences in RBBB without and with structural right ventricular (RV) disease.

Research Question

- We hypothesized that QRS-T VTI in patients with RBBB would be a marker for adverse RV remodeling.
- Our aim was to evaluate quantitative ECG predictors of echocardiographic RV measurements.

Methods and Materials

- We included adults with ECG demonstrating typical RBBB and echocardiogram performed within 3 months of each other in 2010-2020.
- Orthogonal X, Y, Z ECG leads were reconstructed using Kors's matrix.
- QRS duration, QRS voltages and QRS/QRS-T VTIs from 12 standard leads, X, Y, Z leads, and 3D (root-mean-square) ECG were evaluated.
- Age, sex and BSA-adjusted linear regressions were used to assess associations between ECG variables and echocardiographic RV measurements.
- We separately generated ROC curves for predicting abnormal RV measurements from ECG variables.

Table 1a. Prediction of echocardiographic RV variables by ECG*

	QRS Duration		Amplitude _{QRS}		VTI _{QRS-T} √BSA	
	t-score	p-value	t-score	p-value	t-score	p-value
TAPSE	0.55	0.6	-2.42	0.02	-4.05	6 x 10 ⁻⁵
TDI RV S'	-1.55	0.1	-3.43	0.0006	-5.26	2 x 10 ⁻⁷
RV basal diameter	-1.11	4 x 10 ⁻⁵	-1.16	4 x 10 ⁻⁵	6.31	5 x 10 ⁻¹⁰
RV mid diameter	4.56	6 x 10 ⁻⁶	3.17	0.002	5.38	1 x 10 ⁻⁷
RVSP	2.46	0.01	-2.22	3 x 10 ⁻³	5.90	3 x 10 ⁻⁹

* Multivariable adjusted for age, sex, BSA

Table 1b. Area under curve (AUC) from ROC curves for prediction of bivariate echocardiographic RV outcomes by VTI_{QRS-T}√BSA

	AUC	Cutoff, μVsm	Sensitivity (%)	Specificity (%)
TAPSE ≤1.7 cm	0.588	62	52.1	63.8
TDI RV S' ≤10 cm/s	0.621	62	55.6	65.5
RV basal diameter†	0.621	62	53.5	65.1
RV mid diameter†	0.594	62	54.3	65.5
RVSP >35 mmHg	0.580	62	47.1	61.7
≥3 abnormal (overall)	0.663	62	62.7	65.7
Women	0.599	62	48.6	66.7
Men	0.707	62	71.7	65.2

† Largest sex-specific tertile

VTI, voltage-time-integral; TAPSE, tricuspid annular plane systolic excursion; TDI, tissue Doppler imaging; RV, right ventricular; SP, systolic pressure

Results

- We included **782 patients** (33% women, 71±14 years).
- Amongst the ECG variables, BSA-indexed Z-axis QRS-T VTI (VTI_{QRS-T} Z^{*}√BSA) was the **strongest independent predictor of all 5 echocardiographic RV measurements** (Table 1a).
- VTI_{QRS-T} Z^{*}√BSA cutoff 62 μVsm had a **sensitivity 62.7% and specificity 65.7%** to distinguish presence of **≥3 abnormal out of the 5 RV measurements** (Table 1b).

Conclusion

- Adverse RV remodeling causes augmentation of the anterior-posteriorly directed QRS-T potential which is seen as a change in Z-axis VTI.
- VTI_{QRS-T} Z^{*}√BSA could be used as a marker for right heart dysfunction in patients with RBBB.

Acknowledgements

- This work was supported by a CTSA grant from NCATS awarded to the University of Kansas for Frontiers: University of Kansas Clinical and Translational Science Institute (# UL1TR002366).
- Research reported in this publication was supported by the KUMC Research Institute via Lied Pilot grant to Dr. Noheria

Reference

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KU is an EOI/AA institution.

Presented at: American Heart Association Scientific Sessions, Chicago, IL, November 5-7, 2022