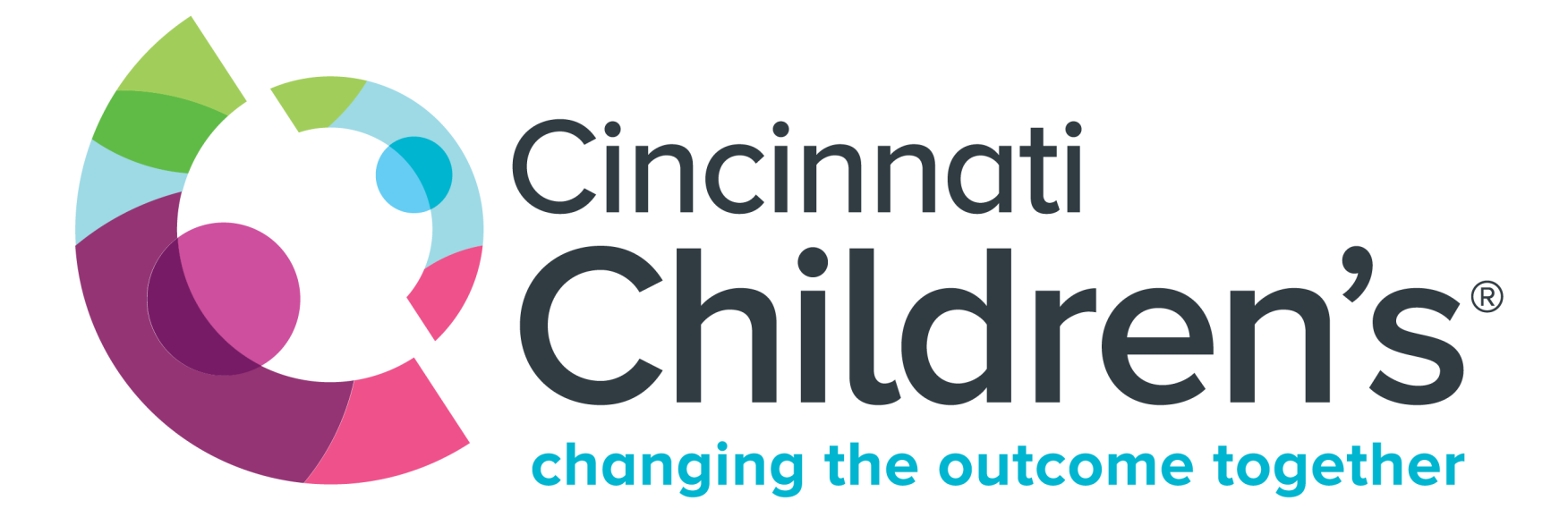


# The relationship between ventilatory anaerobic threshold and arrhythmia onset in patients with catecholaminergic polymorphic ventricular tachycardia

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## Background

- Catecholaminergic polymorphic ventricular tachycardia (CPVT) is a rare genetic condition that causes life-threatening arrhythmias during high catecholamine states and often also at high heart rates (HR) leading ultimately to sudden cardiac arrest
- Management: Medications and activity restriction are mainstay in treatment
- A cardiopulmonary exercise test (CPET) uses a cycle or a treadmill with continuous EKG and metabolic cart to monitor rhythms and cardiorespiratory fitness (VO<sub>2</sub>)
- CPET can also help estimate ventilatory anaerobic threshold (VAT), the transition from aerobic to anaerobic exercise
  - Marker of cardiac fitness level
  - Used in those with and without heart disease to set HR goals during exercise
- CPET is used in CPVT for diagnosis and medication management to regularly monitor a patient's ectopy burden on therapy<sup>1</sup>

1. Al-Khatib SM, et al. 2017 AHA/ACC/HRS Guideline for Management of Patients With Ventricular Arrhythmias and the Prevention of Sudden Cardiac Death: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines and the Heart Rhythm Society. Circulation. 2018 Sep 25;138(13): e272-e391.

## Methods

- Single center, retrospective cohort study
- Study period extended from July 2017 to September 2022
- Included all patients at the institution with the diagnosis of CPVT with CPET testing regularly
- 51 total CPET completed during the study period, 7 excluded for being EKG only without metabolic data collected
  - No tests excluded for low effort or inability to calculate VAT
- VAT was calculated for each test and HR recorded at VAT and points of ectopy
  - Simple ectopy – development of first premature ventricular contraction
  - Complex ectopy – development of ≥ 3 beats of ventricular tachycardia

## Data

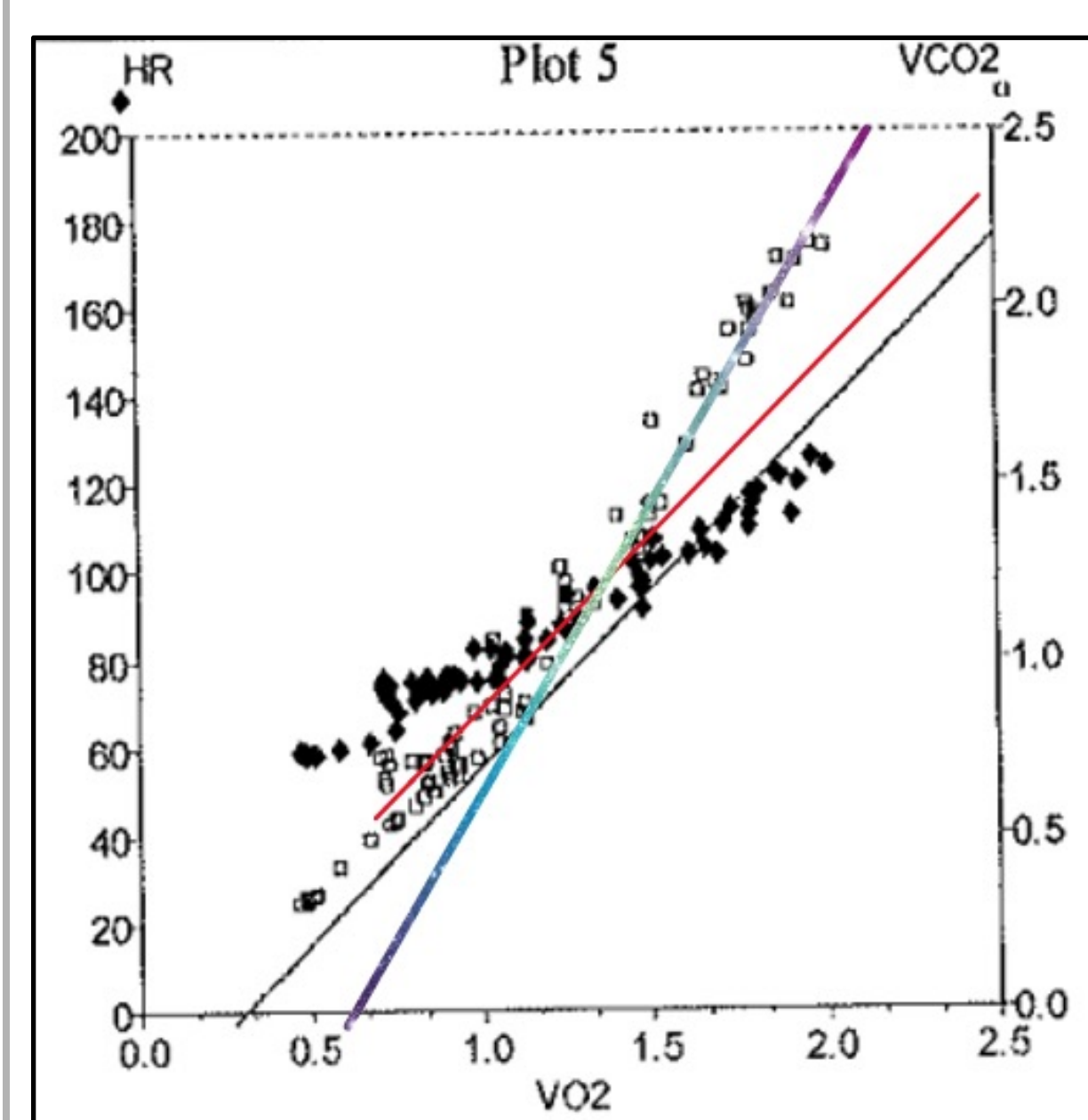
<b>Number of patients</b>	10
<b>Number of tests</b>	44
<b>Age at first test</b>	19.8 ± 10.4
<b>Patients with testing prior to medication initiation</b>	Yes 2 No 8
<b>Sex</b>	Male 5, Female 5
<b>Beta-blocker use</b>	Yes 8 No 2
<b>Flecainide use</b>	Yes 7 No 3
<b>Mutation type</b>	RYR2 Mutation: 9 No identified mutation: 1
<b>ICD</b>	Yes 1 No 9

**Table 1:** Description of the demographics of patients with CPVT included in this study

<b>Simple ectopy present</b>	Yes 34 No 10
<b>Complex ectopy present</b>	Yes 25 No 19
<b>VAT %</b>	51 [33-75]
<b>Peak HR (bpm)</b>	134.2 [106-180]
<b>HR at VAT</b>	101.4 [75-152]
<b>HR at simple ectopy</b>	122.1 [102-173]
<b>HR at complex ectopy</b>	136.8 [106-176]

**Table 2:** Description of the data from the 44 completed cardiopulmonary exercise tests for patients with CPVT. Data is presented as an average with a range.

## Ventilatory Anaerobic Threshold

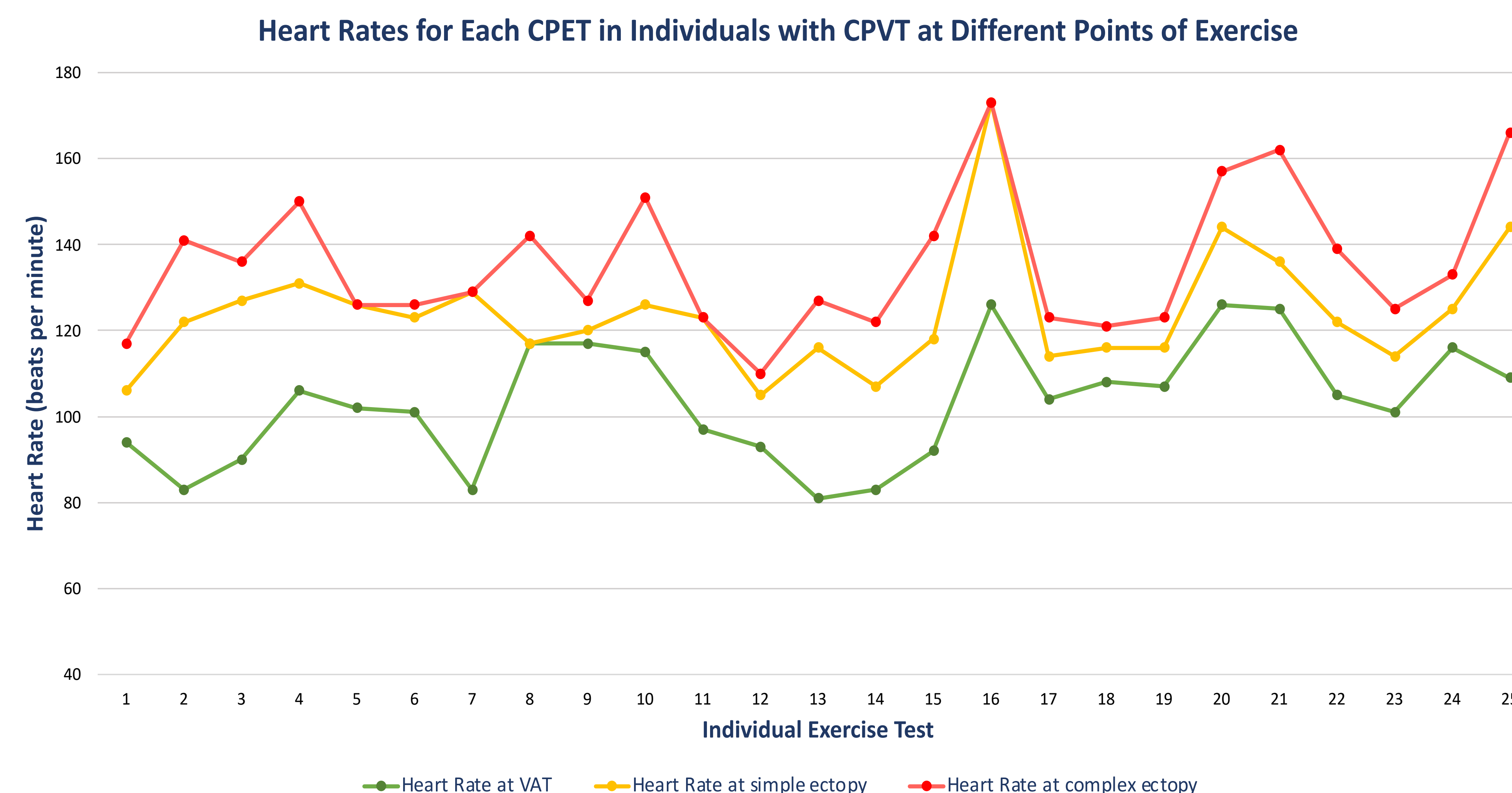


A pane from the 9-panel on a cardiopulmonary exercise test demonstrating the V-slope method in determining the ventilatory anaerobic threshold in a patient with catecholaminergic polymorphic ventricular tachycardia

## Objectives

To assess if there is a relationship between the transition from aerobic to anaerobic metabolism (VAT) and ectopy burden in patients with CPVT

## Results



**Figure 1:** Heart rates at various points in exercise over all 25 serial cardiopulmonary exercise tests in which complex ectopy developed comparing their ventilatory anaerobic threshold and the moment when single premature ventricular contractions (PVC) and polymorphic ventricular tachycardia occurred. Each number along the X-axis represents a single CPET completed with the presence of complex ectopy.

## Conclusions and Next Steps

- VAT was reproducible among patients with CPVT
- VAT was below the development of complex ectopy regardless of stage of treatment
- This could potentially highlight of a possible link between arrhythmia onset and anaerobic metabolism based on the trends in the study
- If this trend is confirmed, exercise with heart rates below the VAT in patients with CPVT could potentially be considered safe
- Consideration of use of burst protocol instead of standard CPET protocol to assess for arrhythmia burden
- Evaluation of lactic acid levels during exercise testing to see if there is an association anaerobic metabolism and arrhythmia onset
- Multicenter trial to have a larger cohort of patients with CPVT with hopefully more genetic variability as well

## Acknowledgements

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Aronoff EB, Baskar S, Czosek RJ, Mays WA, Spar DS, Knilans TK, Powell AW. The Relationship Between Ventilatory Anaerobic Threshold and Arrhythmia in Patients With Catecholaminergic Polymorphic Ventricular Tachycardia. JACC Clin Electrophysiol. 2024 Feb;10(2):373-375.