Resident Scholarly Project / Resident Proposal
Complete the following:

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Title of Project: Exercise ECG as a Predictor of Outcome in Pediatric Pulmonary Hypertension

Brief Background :

Exercise testing is a useful tool in assessing exercise capacity and functional status of the heart in congenital heart disease, cardiomyopathy, and pulmonary hypertension. This includes many measures, including heart rate, O2 consumption, blood pressure, and ECG. This is a non-invasive way to monitor clinical status, which is used to monitor efficacy of treatment or screen for early signs of deterioration and the need for further evaluation (i.e. cardiac catheterization).[1,2] In pulmonary hypertension the 6-minute walk test and cardiopulmonary exercise testing are two of the main methods used to monitor functional status and disease progression.

The exercise ECG is used during cardiopulmonary exercise testing to detect exercise-induced arrhythmias and ischemic changes, especially to signal when exercise testing must be terminated due to risk of adverse events (i.e. ST segment depressions).[3] However, it has been shown that pulmonary hypertension poses an increased risk for arrhythmia, as RV and RA dilation and stretch can disrupt electrical pathways, and studies have shown significant arrhythmic burden in patients with pulmonary hypertension.[4] Therefore, exercise ECG may have additional utility than what is currently known.

Predictors of poor prognosis in pediatric pulmonary hypertension include declining exercise tolerance or functional capacity, syncope, changes on echocardiography and ECG (such as RA/RV enlargement, R-axis deviation, RV hypertrophy), and especially hemodynamic measures seen on cardiac catheterization.[5] Although standard ECG is routinely used in the outpatient monitoring of pulmonary hypertension, the use of exercise ECG as a prognostic measure has not been studied. Exercise ECG may give valuable information that could predict future arrhythmias, syncope, or poor outcome.

Aims or Hypothesis:

We propose that exercise ECG can detect subtle changes that may be used as prognostic measures in pulmonary hypertension. We aim to examine exercise ECGs for all cardiology patients diagnosed with pulmonary hypertension to detect any changes that are correlated to worse outcomes.

Overall Project Methods:

This is a retrospective study using data that has already been collected. All children above the age of 7 with pulmonary hypertension perform exercise testing at regular intervals (intervals may differ depending on functional status). We will analyze all of these ECGs for any abnormalities, particularly ST depressions. We will correlate these findings with a composite variable of worsening outcome, which is include mortality, listing for lung transplant, receiving lung transplant, or creation of atrial septostomy. We will also correlate these finding to secondary outcomes, including 6-minute walk test,

maximum oxygen consumption during exercise testing, and pulmonary artery pressure as measured on catheterization. Our statistical methods will include T-tests to correlate ECG changes with 6-minute walk test, oxygen consumption, and pulmonary artery pressures. We will use chi-square analysis and create a Kaplan-Meier curve to correlate ECG changes with our primary composite outcome.

References:

1. Massin, Martial M. "The role of exercise testing in pediatric cardiology." Archives of cardiovascular diseases 107.5 (2014): 319-327.
2. Garofano, R. P., and R. J. Barst. "Exercise testing in children with primary pulmonary hypertension." Pediatric cardiology 20.1 (1999): 61-64.
3. Yetman, Anji T., et al. "Utility of cardiopulmonary stress testing in assessing disease severity in children with pulmonary arterial hypertension." The American journal of cardiology 95.5 (2005): 697-699.
4. Middleton, Jennifer Tegan, et al. "Arrhythmic burden and outcomes in pulmonary arterial hypertension." Frontiers in medicine 6 (2019): 169.
5. Lammers, Astrid E., et al. "Diagnostics, monitoring and outpatient care in children with suspected pulmonary hypertension/paediatric pulmonary hypertensive vascular disease. Expert consensus statement on the diagnosis and treatment of paediatric pulmonary hypertension. The European Paediatric Pulmonary Vascular Disease Network, endorsed by ISHLT and DGPK." Heart 102.Suppl 2 (2016): ii1-ii13.