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Maximal Oxygen Consumption Recovery Delay in a Fontan Population

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Describe role of Submitting/Presenting Trainee in this project (limit 150 words): I’m the primary author. I formatted the data for analysis, worked with my mentors to analyze it, and wrote the abstract.

Background, Objectives/Goal, Methods/Design, Results, Conclusions limited to 500 words

Background: Single ventricle patients palliated with the Fontan operation are subject to progressive cardiovascular deterioration during adolescence into young adulthood. This deterioration coincides with declining exercise capacity. Maximal oxygen consumption (VO2peak) less than 50% of predicted is an independent predictor of Fontan morbidity/mortality. In adults, increased post-exercise oxygen uptake recovery delay (VO2RD), a novel index of impaired cardiac reserve capacity and predictor of outcome, was associated with worse heart failure outcomes. VO2RD has not been a routine assessment parameter in pediatrics.

Objectives/Goal: The purpose of this study is to determine the relationship of VO2RD on markers of exercise capacity in the Fontan patient.

Methods/Design: Participants (n=26; 9-18 years; Male=19, Female=7) with Fontan physiology completed a peak exercise study utilizing a cycle ergometer James protocol. VO2 was measured continuously during the test and peak effort was defined as achieving an RER≥1.1. VO2 Work was defined as the slope of the relationship between VO2 and work (Watts) during loaded exercise. VO2RD was defined as the time (seconds) VO2 permanently fell below 90% of VO2peak in immediate recovery. Pearson correlations between VO2RD, VO2peak and VO2 Work were performed. VO2peak and VO2 Work were compared between VO2RD fast (<25 sec; n=10) and slow (>25 sec; n=16) groups utilizing Kruskal Wallis test.
**Results:** VO2\text{peak} was highly variable (~2.5-fold; mean 1.4L/min; range 0.9-2.1 L/min) in the entire cohort with a majority of the participants achieving >50% predicted VO2\text{peak} (n=23). VO2 work slope was variable in the cohort (~2.5-fold; mean 104.9; range 54-126.6). VO2RD was variable in the cohort (mean 24 seconds; range 0-55). VO2 % predicted correlated with age (R²= -0.16, p=0.04). Only mild negative correlation between VO2\text{peak} and VO2RD (R²=0.16, p=0.04) and no correlation between VO2 Work and VO2RD was observed (R²= 0.05 p=0.81). However, those with fast VO2RD had significantly higher VO2\text{peak} compared to slow VO2RD (1.5±0.3 vs. 1.2±0.2 L/min; p=0.03).

**Conclusions:** VO2RD was significantly associated with exercise capacity (VO2\text{peak}) in the Fontan population and is an additional parameter that should be considered in their exercise evaluation. Only 3 participants in our cohort were below the established VO2\text{peak} threshold (<50%) associated with poor outcomes. Therefore, additional metrics of exercise capacity are needed with exercise testing analysis in Fontans. Future investigations correlating clinical status (quality of life metrics, echocardiographic function) to VO2RD are needed to ascertain if VO2RD predicts outcomes in Fontan patients with VO2\text{peak} > 50%.