The Use of Novel Exercise Test Parameters to Predict Adverse Outcomes in Patients with Tetralogy of Fallot

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BACKGROUND

- The CDC reports about 1,660 babies born each year with Tetralogy of Fallot (ToF).
- Despite a complete repair at approximately 4-6 months of age, patients with ToF frequently have residual cardiac defects later in life that require surgical or percutaneous intervention.
- Exercise testing is often performed to evaluate the functional status of ToF patients and assist in the decision regarding need for surgery. However, traditional exercise parameters from these tests have limited predictive ability.
- Novel exercise parameters including oxygen uptake efficiency slope (OUES) and the ventilatory equivalent of CO_2 have been shown to be useful predictors of outcome in other patient populations.

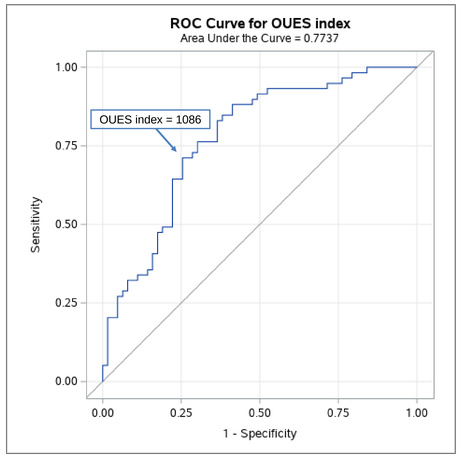
OBJECTIVE

- We aimed to evaluate novel and traditional exercise parameters in patients with repaired ToF and to assess for correlation with adverse clinical outcomes.

METHODS

- Retrospective chart review was performed and patients with repaired ToF who had undergone at least 1 maximal stress test with an RQ > 1.1 were identified.
- Adverse clinical outcomes were defined as surgical or percutaneous intervention within 2 years after a stress test, ventricular tachycardia, or right heart failure requiring medical therapy.
- Univariate associations of exercise test parameters with adverse clinical events were performed using Binary Logistic Regression, generating ROC curves and Youden's J statistics for novel parameters.

RESULTS



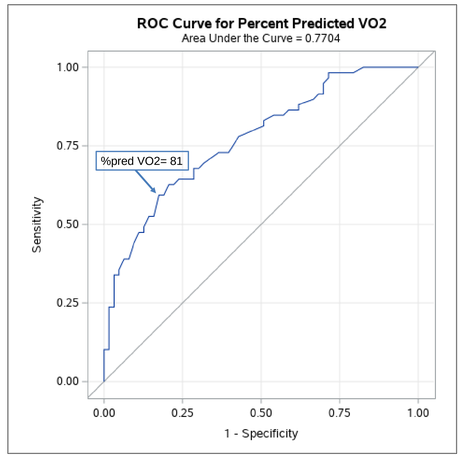


Figure 1: ROC curves and Youden's J statistics for novel parameters

Exercise Parameter	Adverse Outcome	No Adverse Outcome	P-Value
OUES/BSA	960.18	1216.51	<0.001
OUES	1739	1963	0.046
VE/VCO_2	31.52	31.07	0.671
% predicted VO_2 (ml/kg/min)	66	86	<0.001

Table 1: Exercise parameters and relationship to adverse outcomes

- 68 patients with repaired ToF underwent 122 maximal stress tests from 2014-2019, with a range of 1-6 tests per patient.
- The sample was 38% female, 62% male, and mean age at testing was 24 years.
- 52% of tests were associated with an adverse clinical outcome as defined herein.
- Lower OUES/BSA values (960.18 vs. 1216.5; $p < 0.001$), lower percent predicted indexed VO_2 (66 vs. 86, $p < 0.001$) were associated with adverse clinical outcome.

CONCLUSION

- Half of children and young adults with TOF have an adverse outcome.
- Exercise testing may be used to evaluate patients' current functional state and results of exercise testing can predict the patient's risk of an adverse clinical outcome.
- OUES is a useful clinical indicator when evaluating these patients and may provide extra value particularly in those patients with obesity who may have an artificially lowered indexed oxygen consumption.
- Patients presenting with an OUES/BSA value less than 1,086 or a percent predicted VO2 value less than 81% should be monitored closely for possible adverse clinical outcomes.
- Future directions including developing a prospective validation tool to predict those at risk for an adverse outcome.