

Impaired Autonomic and Cardiovascular Function to Dynamic Exercise in Children with Autism Spectrum Disorder

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Abstract

Introduction: Autism Spectrum Disorder (ASD) is a complex neurological disorder identified in early childhood and is characterized by impaired social interaction and atypical behaviors. Limited studies reported that children with ASD tend to have higher heart rate (HR) and blood pressure (BP) at rest compared to typically developing children (TDC). Previously, we reported that HR and blood flow (BF) did not alter while BP increased from rest to acute exercise in ASD. Thus, we thought that ASD may have impaired autonomic nervous system activity to differentially control HR and stroke volume (SV) to regulate BP through changes in cardiac output (CO).

Purpose: To determine differential autonomic and cardiovascular responses to acute dynamic exercise in children with ASD.

Methods: 36 adults, TDC and children with ASD participated in the study. HR from ECG, beat to beat arterial BP from Finapres, and SV from Modelflow, were continuously measured before, during and after 2 minutes of handgrip exercise at 35% and 50% of maximal voluntary contraction. Diameter, velocity, and flow of the brachial artery were measured using Doppler ultrasound on the contracting arm throughout the experiment. HR variability was measured using time and frequency domain analysis.

Results: BP was significantly increased to exercise in all groups with no group differences. HR was significantly increased to exercise in adults and TDC; however, there was no change in HR to exercise from rest in ASD. SV was unaltered from rest to exercise in all groups. Adults and TDC had similar increase in BF to exercise; however, BF did not change in ASD. The rMSSD and high frequency of HRV were similar in all groups while very low frequency HRV was significantly lower in ASD.

Conclusion: HR and BF did not change in ASD indicating impaired autonomic and vascular function. Higher total peripheral resistance may contribute to increase BP during exercise in ASD children without a significant contribution of CO.

Findings

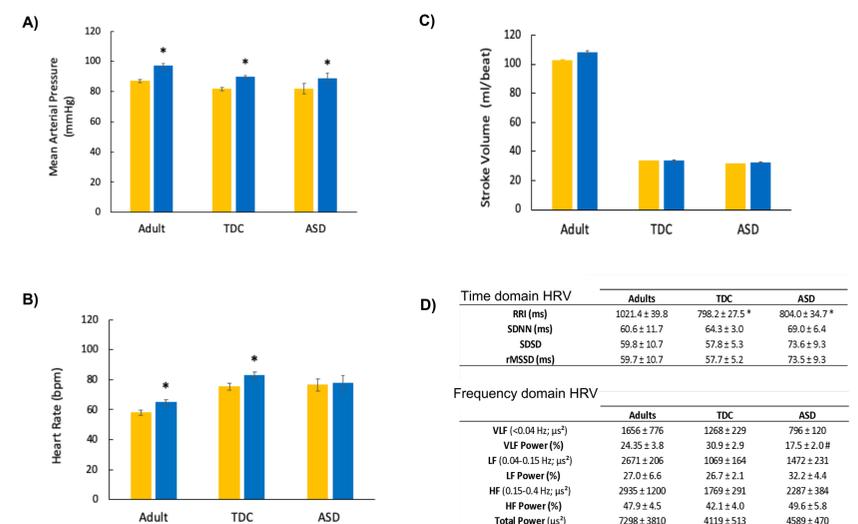
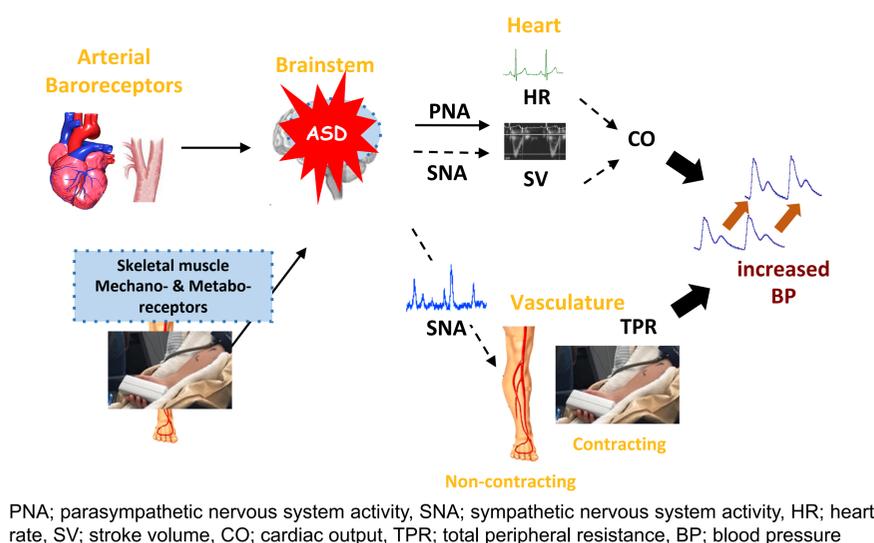


Figure 2. Summary data showing group differences in mean arterial pressure (mmHg, panel A), heart rate (bpm, panel B), stroke volume (ml/beat, panel C), and heart rate variability (HRV, panel D) in resting (ORANGE) and during exercise (BLUE) in adults and children participants. * represent $P < 0.05$ vs. Rest. # represents $P < 0.05$ vs. TDC.

Neural control of blood pressure during exercise in children



Findings

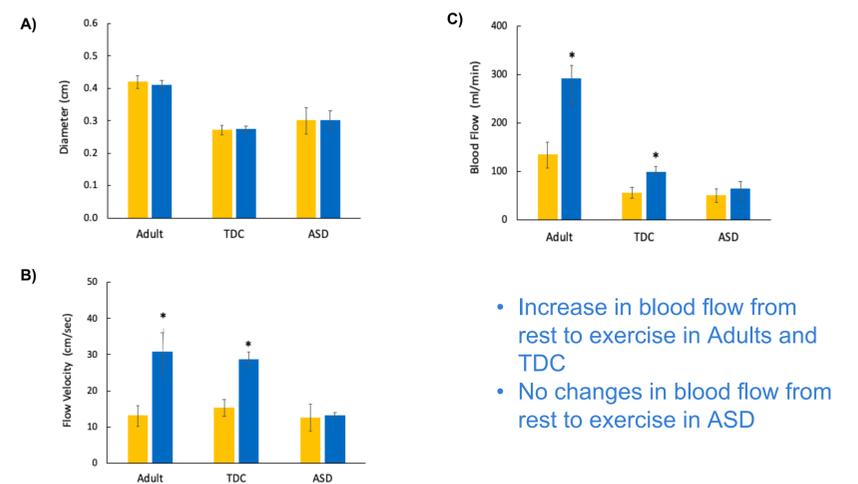


Figure 4. Summary data showing group differences in diameter (cm, Panel A), flow velocity (cm/sec, panel B), and blood flow (ml/min, panel C) of the brachial artery in resting condition (ORANGE) and during exercise (BLUE). * represent $P < 0.05$ vs. Rest. TDC; typically developing children

Methods

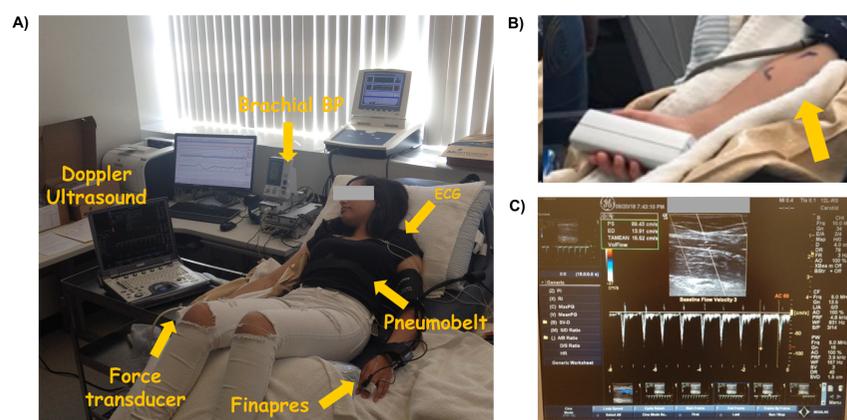


Figure 1. Experimental set-up (panel A), Doppler Ultrasound probe marking and force transducer (panel B), and diameters and blood flow velocity recordings from Doppler Ultrasound (panel C)

Conclusion

Our study suggests there are differential neural control mechanisms to regulate BP in children with ASD compared to TDC or Adults.

Speculations

- No change in HR and lower VLF suggest impaired autonomic function in ASD
- Reduced blood flow response in contracting muscles suggests that children with ASD may have impaired vascular function.
- Higher TPR, from higher sympathetic outflow, may contribute to increase in ASD without significant contribution of cardiac output.
- Increase in BP can be due to decreased dilation in contracting skeletal muscles during exercise in children with ASD.

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