



Cardio-Autism: Improving the Heart-Brain Interface



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Learning Objectives

- To bring attention to the under-recognized connection between the heart and autism and the importance of designing individualized treatments that benefit patients via an improved understanding of their disease.

Current Evidence

- Many studies have demonstrated decreases in both sympathetic and parasympathetic resting activity indicating autonomic under-arousal in ASD children.
- One study found that the children with autism who showed other symptoms of autonomic dysfunction (e.g., sleep disturbance, gastrointestinal problems) demonstrated the lowest levels of baseline vagal activity, supporting reduced vagal control as a physiological marker for pervasive autonomic dysfunction.
- Another study observed reactivity responses to cognitive stressors which revealed atypical vagal increases in autism whereas the neurotypical individuals maintained baseline levels, lending support for atypical reactivity to the cognitive stressors in autism.
- The figure below shows results from a study which assessed autonomic activity in a group of autistic children using autonomic indices: electrodermal activity (EDA) (Fig 1a,b) and a sympathetic index and short-term heart rate variability (HRV), which is predominantly mediated by cardiac vagal control. Results showed lower HRV indices (logHF-HRV) and decreased EDA indicating impaired both sympathetic and cardiovagal regulation at rest in ASD children.

Figure 1: Electrodermal activity (EDA) during rest:

A) The individual values of EDA in control group (white bars) and children suffering from autism spectrum disorder (ASD) (shaded bars).
B) Mean EDA in control group and children suffering from autism spectrum disorder (ASD). * p<0.05.

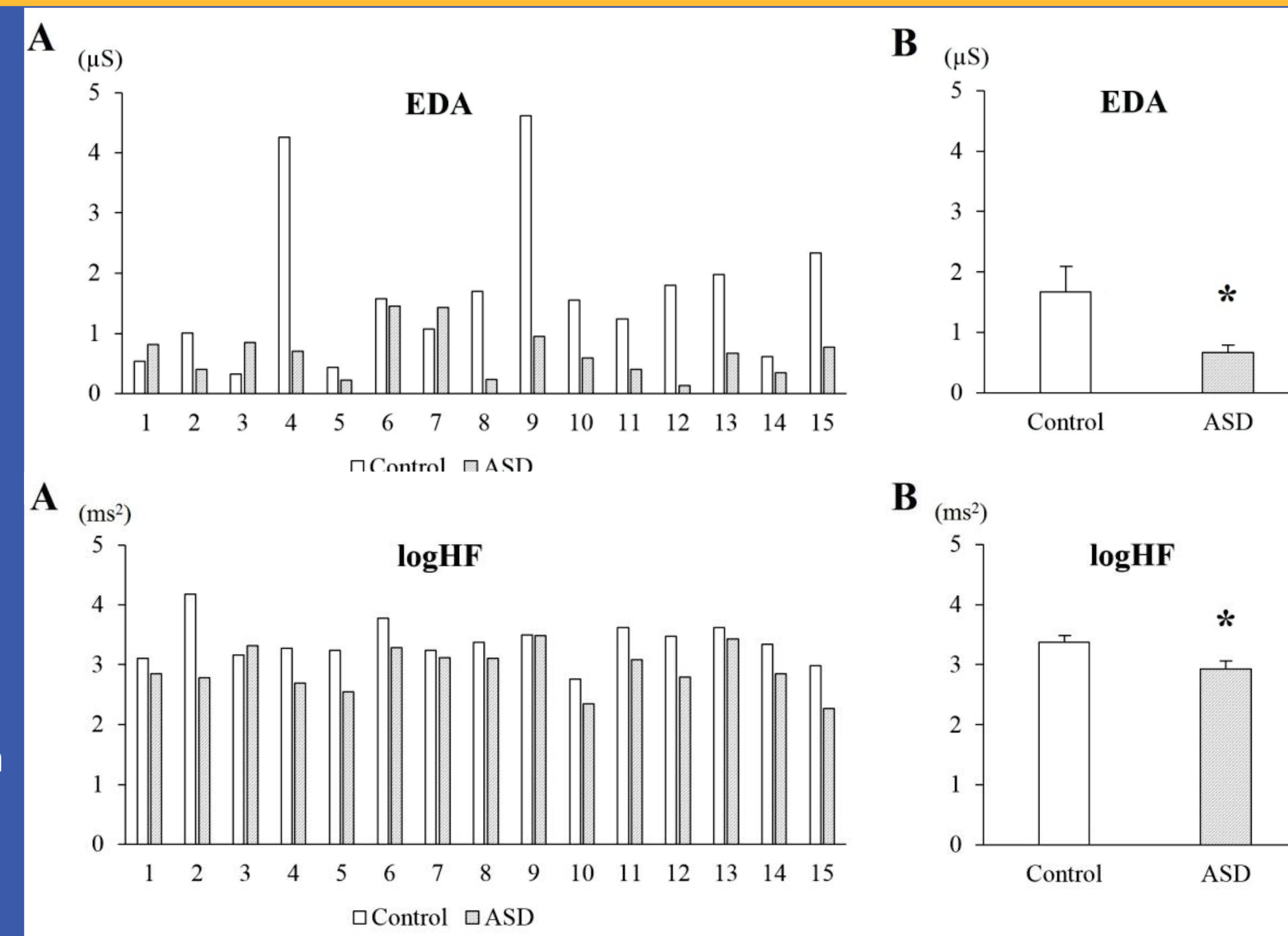


Figure 2: The high frequency band of heart rate variability (logHF-HRV):
A) The individual values of logHF in control group (white bars) and children suffering from autism spectrum disorder (ASD) (shaded bars).
B) Mean values of logHF in control group and children suffering from autism spectrum disorder (ASD). * p<0.05.

Discussion

Proposed Interface Models

The Central Autonomic Network model proposes to account for the connection between autonomic functioning of the heart and psychobiological health, and more specifically, social behavior. This model identifies a functional network of cortical structures and pathways within the central nervous system (which includes the amygdala and hypothalamus, among other structures) which appear to support behavior and adaptability. This proposed network is hypothesized to control sympathetic and parasympathetic motor neurons, as well as respiratory and neuroendocrine outputs and is mediated through sympathetic and parasympathetic projections that innervate the heart via the vagus nerve, directly linking the output of the network with heart rate variability.

Polyvagal Theory provides an evolutionary framework to support physiological regulation (and the broader autonomic system as regulated by central mechanisms through the vagal nerve) as a mediator of social behavior. From an evolutionary perspective, social engagement is an adaptive behavior that promotes survival. Polyvagal theory posits that the phylogenetically newer branch of the vagal nerve, the ventral vagus, evolved over time to include myelinated pathways that allow for adaptive, transitory responses to environmental challenge via the vagal brake. This system facilitates either social engagement or mobilization and defense and does so while conserving metabolic resources by allowing sympathetic tone to be expressed without activating the sympathetic-adrenal system.

Implications

- We assume that the assessment of early and subclinical symptoms of impaired complex neurocardiac regulation could elucidate potential pathomechanism leading to cardiovascular and other complications associated with ASD.
- Intensifying awareness of cardiac disease in the special needs population will better address the interface of heart-brain disorders and can lead to development of novel diagnostic equipment and therapies. More physician attention to seeing cardiac and neurologic diseases, like autism, in continuum, and not in isolation, is imperative to treating patients appropriately.
- Exploring the mechanisms linking autism with cardiac autonomic dysfunction, congenital heart disease, and clinical neuro-cardiology syndromes helps provide insight into biological etiologies and behavioral sequelae that can have significant treatment implications for affected patients with autism and associated cardiac conditions, as well as counseling of the caretakers and families who are also impacted by these disease processes.