Neuroplex-C Project

Introduction and Overview of Foundations and Objectives

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Preface

This is a brief text summary. Its purpose is to provide the basis for constructive, collaborative discussion relating to participation and engagement in a long-term, multi-participant, multi-institutional project. The work, underway currently and proposed for the future, spans the range of fundamental biomedical and computational research, experimentation, clinical tests and trials. The central topics are within an area of the life sciences that pertains to neurology, cardiovascular medicine, and public health including aspects of population health equity and other public health interests. This introduction is an invitation to dialog, directed in particular to persons working within or otherwise responsible for research and clinical programs in relevant specialties of medicine, mathematics, physics, computer science, bioinformatics, and public health.

Project Statement

There are consistent findings indicative of a strong causal relationship between stressor-induced dysfunctions within the autonomic nervous system and severe systemic disorders that include cardiac arrhythmia (specifically variations of tachycardia including SVT, AFIB and POTS), as well as gastrointestinal disorders such as IBS and POI. We consider a theoretical framework wherein chronic stressors of electrochemical nature affect both sympathetic and parasympathetic functions in a manner that originates and sustains degenerative noise effects within neuronal signaling pathways, thereby leading to a variety of dysautonomia conditions, including aforementioned cardiac disorders. One leading hypothesis is that measurable neuronal signals demonstrate distinctive patterns over time which can be prominent and decisive indicators of such degenerative actions, and that such identification can be made in advance of such degenerative conditions being noticeable in clinical examinations (e.g., EKG and echocardiography), or in typical clinical and personal observation of symptoms such as are typically the precursors to more formal diagnostics and treatments.

We focus upon applying a set of mathematical techniques for modeling neuronal signals as topological patterns of tangles and knots which can be simplified into a finite set of categories, certain of which will stand out as precursors to such pathologies as (diverse) tachycardia and also other cardiomyopathic conditions (including myocarditis and potentially precursor stages of myocardial infarction). We assert that the technology for obtaining the requisite signal data for this “topological-order” analysis is sufficient in current EKG that is in wide use clinically, including such compact, portable, personal-use instruments are are currently available commercially for at-home usage.

The analysis of these topological signal structures (dynamical patterns) can thereby enable rapid and population-wide early detection of conditions warranting further medical treatment of both prophylactic and therapeutic nature, thereby offering potential major advantages in healthcare.

These advantages include reducing the probability for serious, critical and fatal consequences, minimizing hospitalization and surgical procedures, and overall aiding in the increasingly-present critical need for population health equity, particularly for segments of the general population that are less likely to receive early or in-time medical examination and treatment.

Further, we consider that advances in the aforementioned analytics and diagnostic procedures can lead to a deeper understanding of the mechanisms by which certain of these pathologies, particularly many variants of tachycardia, develop in terms of neuronal growth and the physical topology of pathological new-growth networks ("neuronal overgrowth") within affected tissue such as the heart. Our objective is to achieve an understanding of such growth mechanisms in a manner that can lead into development of new modes therapeutic techniques that will reverse such dysfunctional growth, by use of non-invasive, non-pharmaceutical action. Such future therapies may, for instance, incorporate low-current electromagnetic stimulation (including ultrasonic or subsonic frequencies) that can result in diminished new neural "overgrowth" and even reversal of such "overgrowth". While this aspect of the Project is still at a theoretical level, there is promising evidence from other studies in biology and medicine, and we are confident that further success in the diagnostic-value component of signal analysis can point the way to innovations for constructive treatment that obviates the need or strengthens the long-term positive effects of ablation, electrocardioversion and pharmaceuticals.

We believe that the problems being addressed by this Project are of critical importance for healthcare across all population demographics, particularly following the emergence and continuation of the COVID pandemic phenomenon. The COVID-19 pandemic provides strong evidence for increased incidence of cardiomyopathy and conditions such as POTS, as well as lower-frequency but significant-number incidences of neurological and gastrointestinal effects. The global statistics of such COVID-related "ancillary" pathologies point to autonomic nervous system dysfunctions as well that affect brain, gastrointestinal and endocrine functions. Worldwide, these problems also are significantly higher in the same population segments that, due to a variety of socioeconomic, educational, cultural, and especially economic factors, are historically and currently receiving less-than-adequate diagnostics and treatments pertinent to exactly these range of health conditions.

Furthermore, we now witness a significant and indeed dramatic increase in psychophysical pathologies that are classed as traumatic stress and post-traumatic stress disorders, emerging from a variety of psychosocial triggers and catalysts. These disorders are firmly identified as catalysts and accelerants for the type of severe dysautonomia that are addressed centrally within this Project. Consequently, we can forecast an increase in the types of medical conditions, cardiovascular and otherwise, for which the positive outcomes from this Project will be beneficial. Healthcare providers will be able to provide earlier, more accurate and more specific diagnoses and also potentially a suite of new therapeutic alternatives which will be simpler, faster, less stressful, and less costly to individuals and health providers. In both diagnostic and therapeutic prospects, the results will be more acceptable to all people worldwide.

Therefore, we invite constructive and collaborative dialog leading toward all levels of engagement, including participation, support, and sponsorship, among individual professionals and consortium-capable institutions.

Key concepts:
Dysautonomia, arrhythmia, tachycardia, myocarditis, AFIB, SVT, POTS, topological order, ANCES (autonomic neurophysiological control and electrochemical stress), PHE (population health equity).

Further scientific, technical, and project-related information is available upon request and dialog.

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