

Autonomic Nervous System Functioning in Patients with Post Viral Syndrome: A Case-Series Study of a Healthy Control Subject, a Long Covid patient and a ME-CFS patient.

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ABSTRACT

There has been concern about possible long-term sequelae of COVID19 infection resembling Myalgic Encephalomyelitis/Chronic Fatigue Syndrome (ME_CFS) in COVID-19 patients. Post infectious, myalgic encephalomyelitis/chronic fatigue syndrome (ME/CFS) like symptoms have been widely observed in COVID19. It is suggested that Long COVID, or post-COVID syndrome (PCS), like ME/CFS, may be related to a virus-or immune mediated disruption of the autonomic nervous system (ANS) (Dani et al., 2021).

BACKGROUND

A recent review on lessons learned from past epidemics suggests that potential long term health complications may be associated with COVID19 (Islam et al., 2020). There has been concern about possible long-term sequelae resembling ME/CFS in COVID-19 patients (Wostyn, 2021). Post infectious, ME/CFS like symptoms have been widely observed in COVID19 and across a variety of other viral and non-viral infections (Islam et al., 2020) and it is suggested that COVID-19, like ME/CFS, may be related to a virus-or immune mediated disruption of the autonomic nervous system (Dani et al., 2021). ME/CFS is a complicated disease characterized by extreme fatigue that cannot be relieved by rest. Amongst its major symptoms are post exertion malaise, sleep dysfunctions, pain, neurological/cognitive manifestations, and deficits found in autonomic-, neuroendocrine-, and immune system functioning (Holgate et al., 2011; Komaroff, 2017, 2019).

Long COVID, or post-COVID syndrome (PCS), is not a single condition, and has been defined by the National Institute for Health and Care Excellence (NICE) as “signs and symptoms that develop during or following an infection consistent with COVID-19 which continue for more than 12 weeks and are not explained by an alternative diagnosis.”

Hypocortisolism is found in CFS populations and, more recently, also in COVID-19 populations (Heidarpour et al., 2020; Mongioi et al., 2020; Nijhof et al., 2014; Pal & Banerjee, 2020; Tak et al., 2011; Tanriverdi et al., 2007). As such there is an urgent need for investigation of Long Covid.

Testable hypotheses derived from recent Long Covid literature (Dani et al., 2021; Goldstein, 2020) are those biomarkers of autonomic nervous system activation could correlate with clinical and pathophysiologic data and could act as prognostic markers in both ME/CFS and PCS disease trajectory and recovery.

OBJECTIVES

- The functioning of, and flexibility of (homeostasis), the cardiovascular and neuromuscular systems was examined using Heart Rate Variability analysis, Micro-vibrational System (MVS) assessment (measured as skeletal muscle tone during rest) and oxygen saturation.
- Objective was to measure to what extent bodily systems are affected by stress-processes, how coherent.
- Heart Rate Variability (HRV) is a non-invasive procedure of importance: It permits an objective/quantitative impression of the capability of the cardiovascular system to regenerate itself. It also gives an empirical insight into the functioning of the ANS. As a rule, less variability/ oscillation in heart rhythm is an indication of higher stress, of the heart, and the organism.
- The Micro-vibrational System (MVS), defined as skeletal muscle tone during rest, is a method developed by Prof. Peter Weinberg and Dr. Christof Ziaja at the Institute for the Science of Sport, University of Hamburg, in cooperation with the Olympic Centre in Hamburg.
- MVS analysis informs us about the energetic efficiency of muscular co-operation. An inefficient co-operation leads to permanent tension (a heightened muscular tone) and thus to overall exhaustion, permanent tension of muscular groups, and imbalances and blockages of muscles and joints.

METHODS

- This case study series examined cardiovascular and neuromuscular systems functioning using HRV analysis (in supine position), and MVS analyses Hz of musculoskeletal silent tremor.
- Equipment used was i) Nerve Express HRV System, ii) Kubios HRV, and iii) Faros 180 Sensor and analyses software.
- Low Frequency (LF) (0.04 Hz - 0.15 Hz) and very/ultra-LF (VLF/ULF; 0.015 Hz - 0.04 Hz) correspond to a hypothalamic-pituitary axis stress response and sympathetic nervous system activation (Post/Pre Ganglion-Cells- and A/Delta C-Fiber).
- ME/CFS and PCS diagnosis were established using a combination of clinical diagnosis, self-report measures and ICD-10 coding.

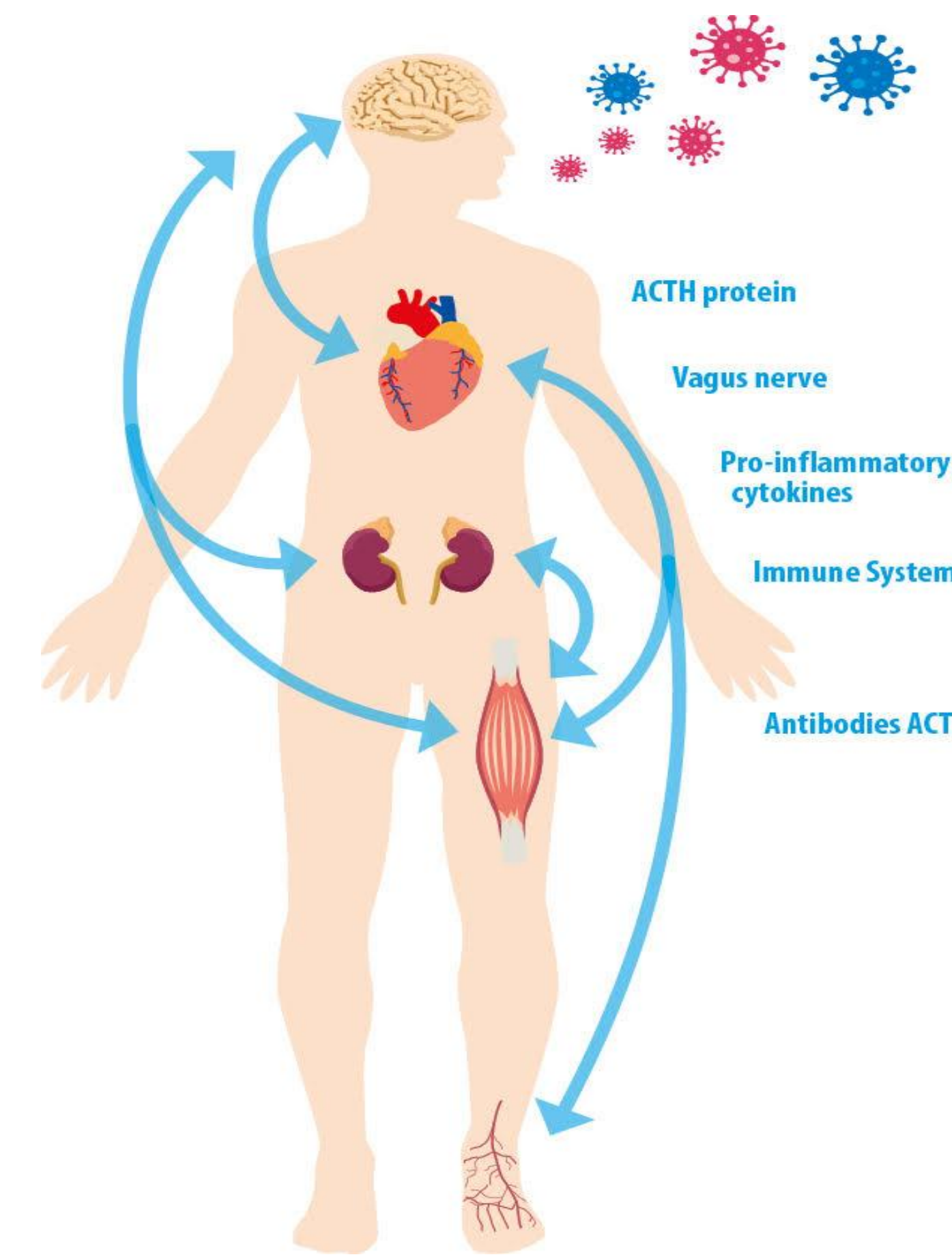


Fig. 1 Shows proposed pathways of viral - and bodily system interactions.

RESULTS

Heart Rate Variability with EKG

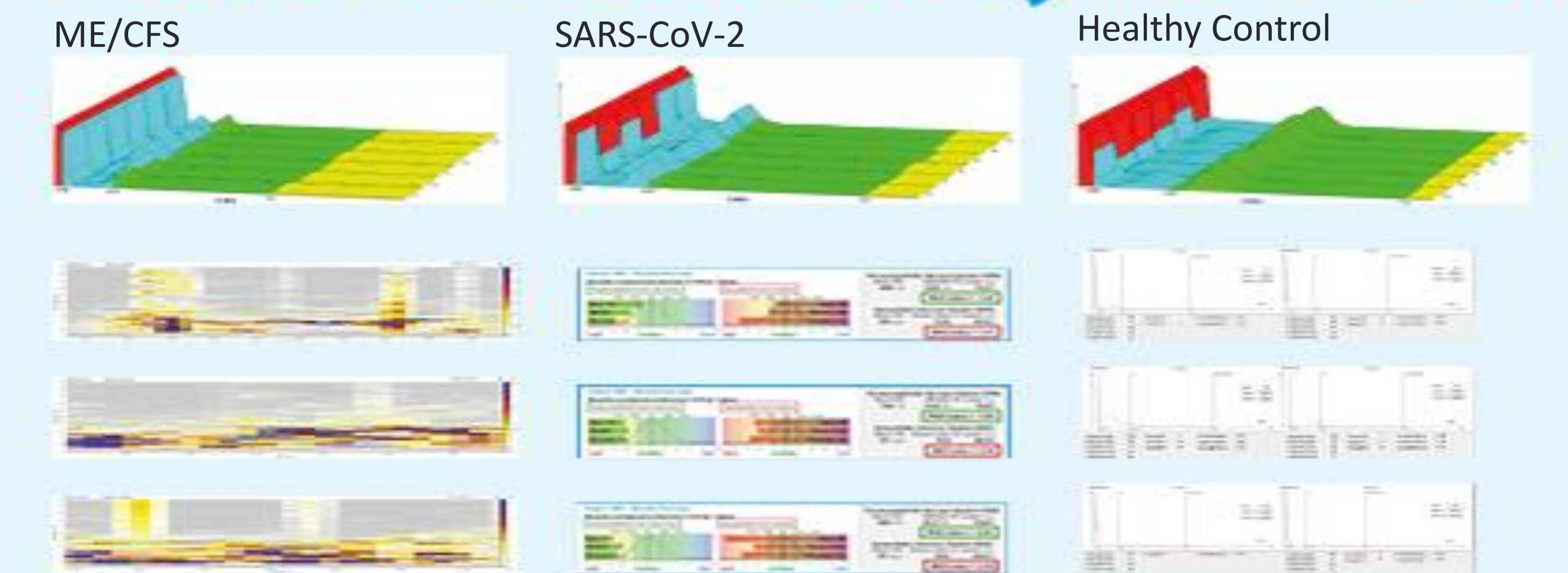
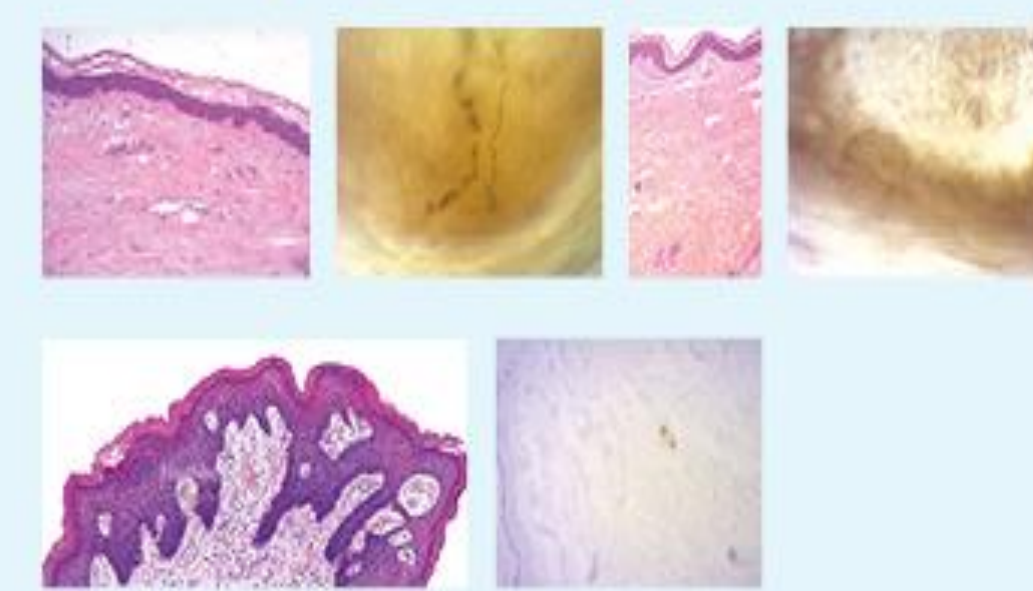


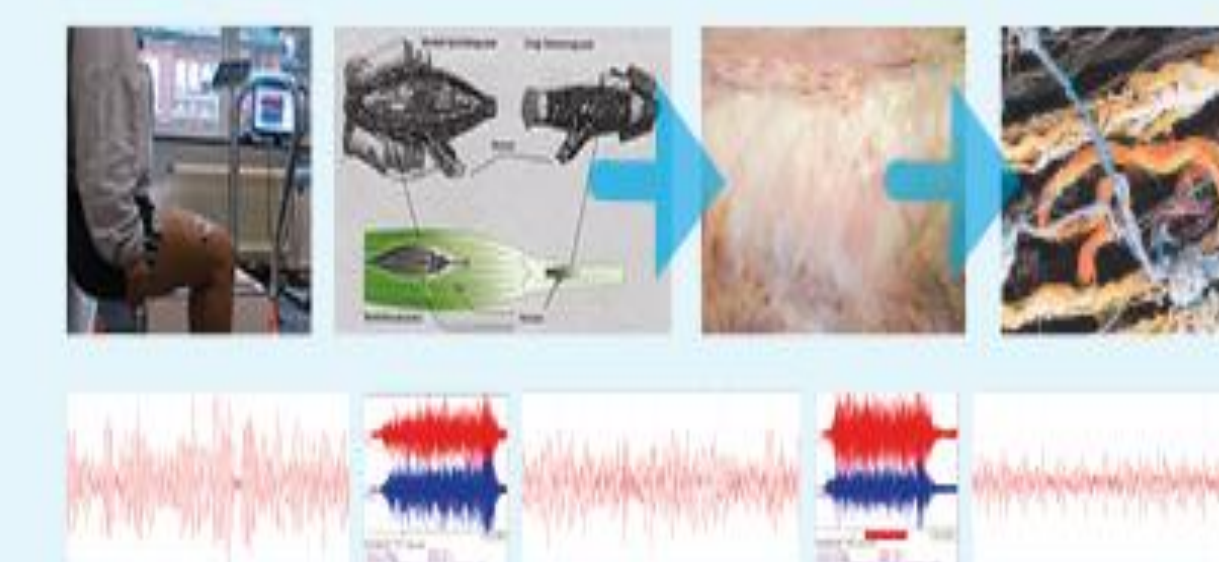
Fig. 2 cardiovascular and neuromuscular systems functioning using HRV analysis (in supine position), and MVS analyses Hz of musculoskeletal silent tremor.

RECOMMENDATIONS FOR FUTURE RESEARCH

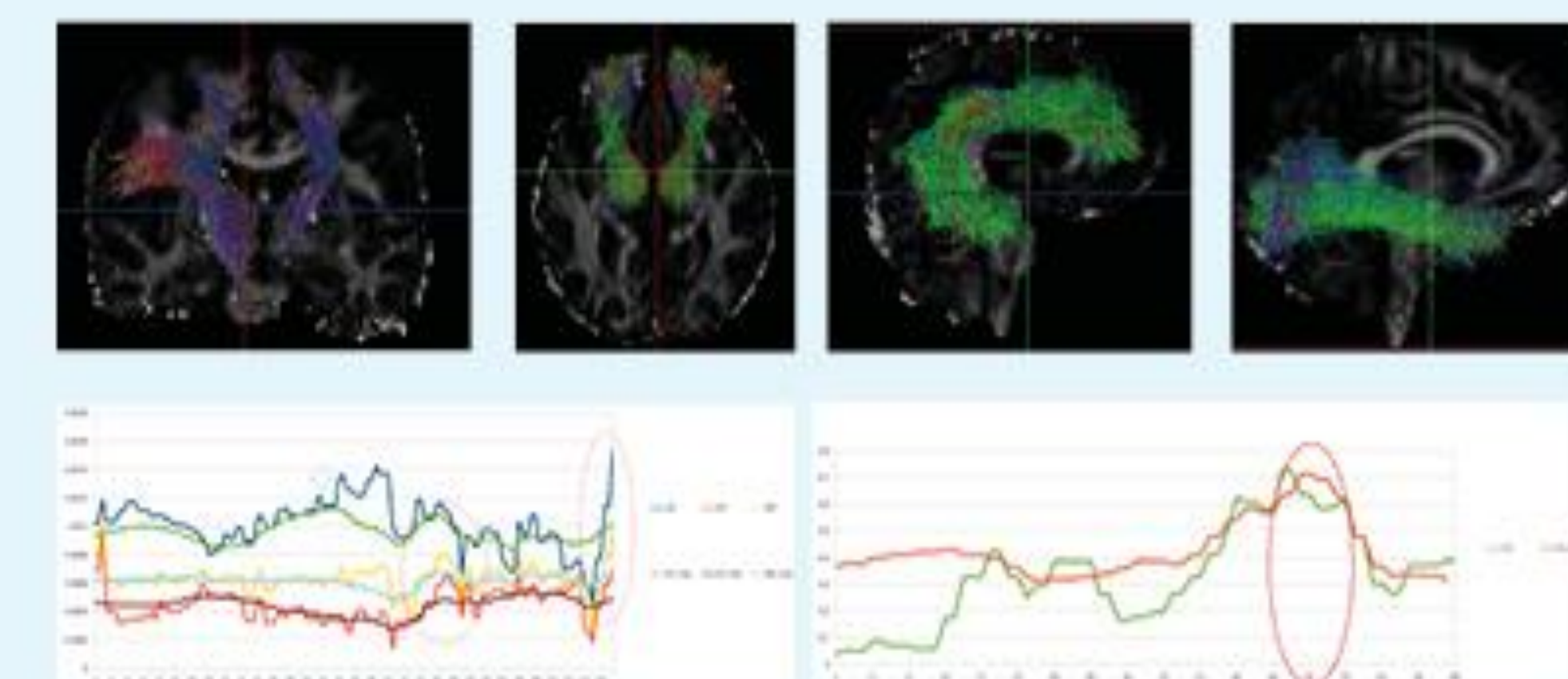
Skin diagnostic C-small Fiber Intraepidermal nerve fiber density (IENFD)



Skelett-Muscle to EMG and fascial interaction



Brain in DTI analyse four area's in Fractional Anisotropy



RESULTS

- The 3 participants were female (Age $M= 50$, $sd= 5$), measured at rest for a period of 30-45 minutes in supine position.
- HRV measurements of both the PCS and ME/CFS patients showed high sympathetic nervous system activation (LF and VLF/ULF ranges), specifically, the LF bandwidths (Long Covid; 0.02 - 0.15 Hz; EDR <0.2, ME/CFS, LF= 0.02-0.23 Hz, EDR = 0.15-0.23).
- The PCS patient showing a compression in the ULF range (ULF= 0.09-0.1 Hz, 71-85 resting heart rate), whilst the HC subject showed parasympathetic nervous system recruitment (0.25 Hz) after an 8-minute supine position.
- Low Total Power values PCS (Post Covid Syndroms) TP = 362 - 452 lying down with a pulse of 70-74 with a sympathetic graph represented by the red line with dots that remains at 1 / Parasympathetic green remains well below 0 line -2 to -1; the ME/CFS patient TP = 575 -280 lying down with a pulse of 79-89 (line red sympathetic >1 and parasympathetic <0 / -4) and the control person TP = 1679 -348 lying down with a pulse of 55-57 (line red sympathetic = 0 and parasympathetic = 0).
- A noticeable phase shift of the MV in both patients was noted as compared to the HC.
- The interaction of the cardiovascular and MV systems illustrate a the burn-out like state caused by high body tension. (High vibration = high entropy = low energy = chronic fatigue) Covid-19 patient MV = 14 Hz, ME/CFS MV = 13, control person MV = 6 Hz.

CONCLUSIONS

- In line with an emerging body of research our comparisons of cardiovascular and musculoskeletal outcomes of the 2 patient subjects show comparable rates of autonomic nervous system dysregulation, increased skeletal muscle tone and decreased oxygen saturations, compared to the healthy control subject.
- Further research into autonomic dysregulation in PCS and ME-CFS is thus warranted.

ACKNOWLEDGEMENTS

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