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Peer Review

Review of: "Intermittent Pneumatic Compression as a Regulator of Physiological Processes: A Conceptual Framework"

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The review article by Dmytro Zaitsev on "Intermittent Pneumatic Compression as a Regulator of Physiological Processes: A Conceptual Framework" is a timely and useful review of the IPC method and well worth publishing in Qeios. I have a couple of suggestions for improvement.

#1. On page 4, the author states "*This approach produced approximately five compression waves per minute—a much larger "dose" of mechanical influence per unit of time. We theorized this 1 Hz frequency was close to the heart rate, allowing for potential synchronization with the body's natural vascular oscillations. If validated (as, for example, in [6]), this principle could pave the way for future biofeedback systems that adjust compression frequency to correct specific physiological imbalances.*"

However, 5 waves per minute is closer to 0.1 Hz rather than 1 Hz (60 waves per minute). Rather than reflecting heart rate, 0.1 Hz better reflects the resonant breathing frequency induced by slow paced breathing (SPB) (6 breaths/minute), where breathing, heart rate variability, blood pressure, and intracranial pressure pulsations become synchronized. The author should discuss the beneficial and mechanistic basis of SPB (see refs. below) as it relates to IPC and its beneficial effects on cognitive function and neuronal plasticity, as he discusses on page 8. These effects of SPB have been recognized for 1000s of years (e.g., in Yoga practices), and IPC adds an interesting possible supplement,

Mather M, Thayer J. How heart rate variability affects emotion regulation brain networks. Curr Opin Behav Sci. 2018 Feb;19:98-104. doi: 10.1016/j.cobeha.2017.12.017. PMID: 29333483; PMCID: PMC5761738.

Wang J, Hamill OP. Piezo2-peripheral baroreceptor channel expressed in select neurons of the mouse brain: a putative mechanism for synchronizing neural networks by transducing intracranial pressure

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pulses. J Integr Neurosci. 2021 Dec 30;20(4):825-837. doi: 10.31083/j.jin2004085. PMID: 34997707

Hamill OP. Pressure Pulsatility Links Cardio-Respiratory and Brain Rhythmicity. J Integr Neurosci. 2023 Oct 23;22(6):143. doi: 10.31083/j.jin2206143. PMID: 38176935.

#2. On page 17, the author states "*Both intracellular and extracellular ATP (as a purinergic signal) should be considered. Such studies may clarify tissue-specific and dose-dependent metabolic responses to IPC and determine whether it can act as a mild "passive exercise," enhancing mitochondrial efficiency in patients with metabolic disorders. If confirmed, these findings would support IPC as a method of targeted metabolic modulation rather than a purely mechanical intervention*."

This is an interesting speculation that may have direct experimental support in the form of a ubiquitous form of mechanotransduction that should be activated by IPC involving a highly mechanosensitive vesicular release of ATP detected in most cells that is linked to protein processing, membrane insertion, and secretion. The idea that constitutive protein secretion and membrane protein insertion is mechanosensitive seems a feasible mechanism to explain the beneficial effects of IPC. It would be interesting to directly test the IPC protocol on cells/tissues in vitro while measuring ATP release.

Maroto R, Hamill OP. Brefeldin A block of integrin-dependent mechanosensitive ATP release from Xenopus oocytes reveals a novel mechanism of mechanotransduction. J Biol Chem. 2001 Jun 29;276(26):23867-72. doi: 10.1074/jbc.M101500200. Epub 2001 Apr 24. PMID: 11320093.

Declarations

Potential competing interests: No potential competing interests to declare.