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RESEARCH LETTER

Median nerve diadynamic current stimulation for blood pressure modulation

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Electrical stimulation modifies peripheral nerve function and neuromuscular activity by applying controlled electrical currents through the skin [1]. Peripheral neuromodulation offers therapeutic promise for reestablishing physiological balance by using targeted nerve stimulation to control organ and tissue function through bidirectional brain–periphery transmission [2]. The somato-autonomic reflex involves central pathways in which somatosensory stimulation activates autonomic efferents through spinal and brainstem circuits, resulting in organ-specific or systemic cardiovascular responses [3]. The axon reflex is a peripheral process in which neuropeptides such as substance P and calcitonin gene-related peptide are released by sensory neurones antidromically to produce localised vasodilation or vasoconstriction without engaging the central nervous system [4]. Through somato-autonomic reflexes, median nerve stimulation may affect blood pressure. Axon-reflex activity and neurotransmitter release further limit presympathetic drive, supporting physiological blood pressure regulation, while afferent input activates central autonomic nuclei projecting to the rostral ventrolateral medulla, suppressing sympathetic outflow [5]. This study uniquely investigates diadynamic median nerve stimulation as a non-invasive method of reducing the sympathetic outflow and modulating blood pressure in a healthy adult.

An apparently healthy 19-year-old man with a body mass index of 23.5kg/m², leading a healthy lifestyle was selected. Comorbid conditions like hypertension, diabetes, and autonomic dysfunction were excluded to provide more reliable physiological responses [6]. Ethical guidelines were adhered to, and an informed consent was obtained prior to commencing the study. This experimental design was adopted to evaluate the effects of diadynamic stimulation on blood pressure regulation. Systolic and diastolic blood pressure were measured using a digital sphygmomanometer (Omron HEM-7120).

Blood pressure measurements were taken on the same arm, after a 5-minute seated rest, at approximately the same time of day. Three readings were taken, with the average value used for analysis. This procedure was replicated during pre- and post-intervention as well as during the baseline/washout weeks. The intervention was conducted over five successive weeks. Systolic and diastolic blood pressures were measured at six time points at one-week intervals: baseline, intervention 1 (week 1), washout (week 2), intervention 2 (week 3), washout (week 4), and endline (week 5). The intervention consisted of applying diphase diadynamic current via surface electrodes placed bilaterally at the volar aspect of the wrist, over the median nerve distribution at the base of the thumb. For the diphase waveform, intensity was set to a comfortable sensory level, individualised to the participant's comfort.

Key messages

Diadynamic current median nerve stimulation affects cardiovascular autonomic output by activating axon-reflex and somato-autonomic pathways. We observed a statistically non-significant decrease in systolic blood pressure, but a increase in diastolic blood pressure in the single cross-over study. The results of this modulationis not conclusive for its use in the clinical settings. Further studies are necessary.

The stimulation frequency was pre-set according to the device's diphase mode using the BTL-4825SL unit and each session lasted 10 minutes. Baseline blood pressure was recorded at Week 0. Diadynamic current stimulation was applied in Weeks 1 and 3 with pre- and post-treatment measurements. Weeks 2 and 4 served as washout periods. Final blood pressure was recorded at Week 5. The one-week interval for a washout was based on previous studies that reported that seven days were long enough to minimise carryover effects in short-duration physiological interventions, and residual changes across the washout phases were visually checked to determine the appropriateness of the interval [7]. To enhance internal validity, the common acute blood-pressure influencers were monitored daily. The participant was instructed to maintain typical daily routines throughout the study in order to minimise variability in behaviour between phases and was closely monitored during every session for comfort and safety.

Table 1 Intervention phases and blood pressure measurements of a 19-year-old man

Week	Phase		Blood pressure (mmHg)	
			Systolic	Diastolic
Pre-test	Baseline	–	121	65
Week 1	Intervention	Pre	127	67
		Post	119	66
Week 2	Washout	–	128	69
Week 3	Intervention	Pre	131	78
		Post	134	64
Week 4	Washout	–	124	67
Post-test	Follow-up	–	118	69

The blood pressure values during baseline and intervention phases are presented in Table 1. Tau-U was used for statistical analysis as it is a non-parametric effect size measure designed for single-case experimental designs. It compares baseline and intervention values pairwise to quantify phase non-overlap, yielding a standardised effect size [8]. The systolic blood pressure was decreased (Week-5 minus baseline) by 3 mmHg but diastolic blood pressure was increased by 5 mmHg. None of these changes were statistically significant.

Following diadynamic current median nerve stimulation, an effect on blood pressure regulation appeared to manifest across the subsequent intervention phases but none of them were sustained for statistical significance. Contrary to the findings of other studies, the diastolic pressure increased paradoxically. This divergent diastolic response may suggest our inability to control extraneous factors in the statistical analysis.

It is hypothesised that diadynamic current changes the autonomic outflow by exciting cutaneous and afferent nerve fibers. Thus, the balance shifts to increased parasympathetic and reduced sympathetic activity [9]. However, the present findings indicate a possible autonomic influence of diadynamic current stimulation, which requires further controlled studies to recommend any therapeutic indication. Subsequent studies may require an adjustment of dosages of electrical stimulation and other indices such as intensity, frequency and duration of the sessions that cause maximal blood pressure changes without provoking side effect or discomfort using a design that can adjust the results for extraneous factors such as objectively measured caffeine and salt intake and physical activity before the measurement of blood pressure.

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Author contributions

Conception or design of the work; or the acquisition, analysis, or interpretation of data for the work: RSS, RK, PBRP. *Drafting the work or reviewing it critically for important intellectual content:* RSS, RK, PBRP. *Final approval of the version to be published*: RSS. *Accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved:* RSS, RK, PBRP.

Conflict of interest

We do not have any conflict of interest.

Data availability statement

We confirm that the data supporting the findings of the study will be shared upon reasonable request.

AI disclosure

After completion of the manuscript, ChatGPT (OpenAI) was used solely for language polishing and grammatical refinement. We critically reviewed and edited all content and take full responsibility for the integrity, accuracy, and originality of the published work.

Supplementary file

None

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