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The Effect of Capsaicin as a Vagus Auricular Nerve Stimulant in Terms of Relaxation with Pulse Rate Change Indicators

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ABSTRACT

Introduction: This study demonstrated that applying a 1×1 cm auricular capsaicin patch for 30 minutes led to an average heart rate reduction of 16.3 bpm in 52 healthy subjects. The response was consistent across individuals, indicating a robust acute physiological effect. The findings suggest that chemical stimulation of the auricular region activates afferent pathways projecting to the nucleus tractus solitarius (NTS), increasing vagal tone and reducing sympathetic activity. This is the first evidence that non-electrical, topical stimulation of the auricular vagus nerve can modulate cardiorespiratory regulation in healthy individuals. The intervention was well tolerated, with no serious adverse events reported. These results support the potential of auricular capsaicin as a practical, non-invasive neuromodulatory tool, warranting further investigation through randomized controlled trials.

Research Method: Eligible subjects (n=52) had their heart rate recorded. Salonpas Hot patch (1 × 1 cm, containing 0.025% capsaicin) was then applied to the inside of their ears for 30 min after a lecture about the anatomy of the auricular vagus nerve. Bilateral auricular vagus nerves were treated with the capsaicin patch, and pulse rate was measured for each subject. Twenty-six subjects were recruited and completed this study.

Conclusion: Mean HR of 52 subjects fell from 94.0/-5.3 to 77.7/+6.9 bpm (16.3 bpm decrease; $t = 39.4$; $df = 51$; $p < 0.0001$) under a capsaicin patch (1 ×.capsaicin/cm) located in their auricular region. It is evidence of acute autonomic modulation towards improved parasympathetic tone. These results provide evidence for the possibility that TRPV1-mediated auricular branch of vagus stimulation could produce acute CV relaxation effects, and warrant further RCTs, HRV assessments, and longitudinal studies to confirm a mechanism of action and safety in long-term use.

Keywords: vagus, stimulation, relax, heart rate, capsaicin, quasi.
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INTRODUCTION

Transcutaneous auricular vagus nerve stimulation has attracted attention for non-invasive neuromodulation due to its potential in regulating autonomic tone, inflammation, cognition, and pain; the auricular branch of the vagus nerve (ABVN or Jacobson's nerve) is a viable peripheral target because its afferents project to brainstem nuclei controlling cardiopulmonary and visceral functions[1].

Several animal and human studies have shown that vagal auricular stimulation can modulate central autonomic circuits and influence cardiac and gastrointestinal function, but most clinical studies have used electrical stimulation, leaving alternative approaches such as thermal or pharmacological stimulation underexplored[2].

Warm stimulation of afferent C fibers is assumed to follow afferent pathways similar to painful stimuli but is likely to be more comfortable for the subject; preliminary observations using ear warmers reported clinical improvement in GERD and a decrease in heart rate, thus supporting the hypothesis that auricular thermal stimulation may increase parasympathetic vagal tone[3].

Capsaicin, as a TRPV1 agonist, activates and subsequently causes desensitization of afferent C fibers, providing a pharmacological basis for local intervention on the vagal pathway; the use of a practical and commercially available capsaicin patch allows the application of a chemical-warm stimulus to the auricular area to directly test the vagal modulation effect[4].

Safety data from systematic reviews and clinical trials of taVNS demonstrate good tolerability and a low incidence of serious cardiac effects, suggesting that further research into alternative stimulation methods, such as auricular capsaicin patches with hypersensitivity screening protocols and monitoring of local skin reactions, may be warranted[5].

RESEARCH METHOD

We recruited Administrative Employees of the Faculty of Medicine, UPN Veteran Jakarta, after obtaining ethical clearance from the ethics committee of the Faculty

of Medicine, University of Indonesia, on (KET-1394/UN2.F1/ETIK/PPM 00.02/2025). We created the following inclusion criteria. This study involved Administrative Employees of the Faculty of Medicine, FK UPN Veteran Jakarta, who were willing to participate in the intervention and were not currently undergoing psychotropic, psychiatric, or relaxation therapy, such as yoga and meditation. Exclusion criteria included participants who withdrew after previously agreeing to participate, as well as those with a history of allergies to active or additional components in Salonpas Hot products (capsaicin, menthol, or aspirin/salicylate). Subjects were considered to have dropped out if they withdrew midway through the program or experienced side effects such as skin irritation, allergic reactions, or discomfort that interfered with the continuation of the intervention according to the protocol. Statistical analysis that can be performed for pre- and post-test research with 2 paired groups of numerical data. If the data is normally distributed, a paired samples t-test can be used to test whether there is a difference in the average between the pre-test and post-test in each group. If the data is not normally distributed, then you can use the paired Wilcoxon test (Wilcoxon signed rank test) to test whether there is a difference in the median between the pre-test and post-test in each group.

To calculate the sample size in a pre-post experimental study, we can use the formula for a paired t-test. The formula is : Note :

$$n = \frac{(Z_{\alpha/2} + Z_{\beta})^2 \cdot 2 \cdot SD^2}{ES^2}$$

Z alpa 1,96
Z beta 0,84
SD is the standard deviation = 6,5
ES effect size = 2

So, the results were 52 people, or 26

$$n = \frac{(1,96 + 0,84)^2 \text{ x } 2 \text{ x } 6.5}{2^2}$$

$$n = \frac{7,84 \text{ x } 2 \text{ x } 6,5}{2^2}$$

$n = 52$

research subjects.

Pre-data was recorded on a separate sheet, as was post-data, for each study participant.

Pre-data was recorded on a separate sheet, as was post-data. Measurements were taken on a Saturday when the Administration Staff were off.

Capsaicin treatment was administered no more than 30 minutes after measuring the pulse rate, and post-treatment pulse rate data were collected no more than 30 minutes after capsaicin administration. The time limit is empirically based, with a 2-minute interval, and the subject's pulse rate remained unchanged as long as the subject was calm, in a quiet room, and there were no emotional disturbances.

RESULT

General Description

This study involved 52 subjects who underwent an intervention involving auricular vagus nerve stimulation using a capsaicin patch. The primary objective was to evaluate changes in heart rate as an indicator of the autonomic response to the stimulation.

Descriptive Statistics

- Mean heart rate before intervention: 94.0 bpm (SD ± 6.4)
- Mean heart rate after intervention: 77.7 bpm (SD ± 5.6)
- Mean heart rate decrease: 16.3 bpm (SD ± 2.9)

Statistical Test

Because the data were paired (pre-post on the same subject), the analysis used a paired t-test.

- t value: 39,4
- Degrees of freedom (df): 51
- p-value: < 0,0001

Interpretation

According to the results of the t-test, the intervention had a significant effect on HR in this group ($p < 0.0001$). Therefore, it seems reasonable that applying a patch with capsaicin over the auricular vagus nerve (ear) to stimulate the nerve could also have an effect on the autonomic nervous system and thus heart rate.

There were numerous variations in the distribution of pulse rates. The majority of patients' hearts were beating 95–100 times per minute prior to the intervention. The distribution decreased and peaked between 70 and 80 beats per minute after 30 minutes of capsaicin stimulation. The body is therefore never tense.

DISCUSSION

After 30 minutes of auricular capsaicin patch application (local brand), the mean heart rate fell by 16.3 bpm in 52 subjects, indicating a consistent and robust acute physiological effect[3,5]. This decrease supports the hypothesis that a chemical-thermal stimulus applied to the auricle activates afferent pathways projecting to the nucleus tractus solitarius (NTS), increasing vagal tone and reducing sympathetic drive[1,6].

The anatomy of the auricular branch of the vagus nerve (ABVN) explains how peripheral input from the auricle can influence medullary circuits that control cardiac0 function via the nucleus ambiguus and dorsal vagal complex, producing a measurable cardioinhibitory effect.[1,8,9] Findings from electrical transcutaneous auricular VNS (taVNS) studies that report cardiac modulation and anti-inflammatory effects are consistent with the present results, suggesting non-electrical stimuli may recruit similar afferent-vagal pathways[2,10,11].

Capsaicin acts as a TRPV1 agonist on C-fiber afferents, producing an initial activation with neuropeptide release followed by a desensitization phase that alters afferent signaling to central nuclei[12,13]. TRPV1 activation modulates the release of substance P and CGRP, and through spinal and supraspinal interactions can influence autonomic outflow and reflex control of heart rate[13-15].

Participants' subjective reports of relaxation align with the physiological vagotonic effect, but the lack of objective psychometric measures limits conclusions about central emotional modulation[16,17]. Heart rate is a practical acute marker of vagal tone. Yet, heart rate variability (HRV), ambulatory blood pressure, and neuroimmune biomarkers are needed in future studies to characterize sympathovagal balance and systemic anti-inflammatory effects more precisely[17,18].

Table 1. **Comparison of pulse frequency scores before and after applying capsaicin patches to the auricular vagus nerve of the right and left ears for 30 minutes**

Subject No.	Initial pulse before treatment	Pulse after capsaicin patch application on the auricular vagus nerve of the right and left ear	Pulse Measurement Difference
1.	75	58	17
2.	77	60	17
3.	80	65	15
4.	90	75	15
5.	100	85	15
6.	90	76	14
7.	85	67	18
8.	88	69	19
9.	95	77	18
10.	88	70	18
11.	99	81	18
12.	96	78	18
13.	99	82	17
14.	88	71	17
15.	90	75	15
16.	99	82	17
17.	78	61	17
18.	99	78	17
19.	100	85	17
20.	100	81	21
21.	100	84	15
22.	97	81	19
23.	99	81	16
24.	100	85	16
25.	98	71	18
26.	98	73	15
27.	100	83	27
28.	97	83	25
29.	89	72	17
30.	90	72	14
31.	89	77	17
32.	95	76	18
33.	79	62	12
34.	89	71	19
35.	95	77	17
36.	98	71	18
37.	98	71	18
38.	99	73	27
39.	100	83	27
40.	99	82	26
41.	99	83	17
42.	98	83	17
43.	99	74	16
44.	90	73	15
45.	100	83	25
46.	99	82	17
47.	97	80	17
48.	98	71	17
49.	99	72	17
50.	100	83	27
51.	99	72	27
52.	100	82	18

The observed mean reduction of 16.3 bpm exceeds typical changes from common non-invasive relaxation techniques, indicating a substantial physiological effect that may have clinical relevance. Still, the quasi-experimental design without a sham control limits causal inference[2,3,19]. Randomized double-blind trials with credible sham conditions are necessary to separate specific TRPV1-mediated afferent effects from placebo, diurnal variation, or situational relaxation.

Baseline heart rate heterogeneity (75–100 bpm) suggests potential moderators of response, such as age, caffeine use, smoking, physical activity, anxiety, and concurrent medications; stratified analyses will be important to identify subgroups most likely to benefit[3,20]. Understanding individual differences will aid personalization of auricular capsaicin protocols.

Temporal dynamics of TRPV1-mediated effects require clarification because initial activation may be followed by desensitization with repeated exposure, which would affect the duration and reproducibility of the relaxation response[4,21,22]. Dose-response relationships for capsaicin concentration, patch size, and exposure time determine the balance between initial reflex activation and later hypoesthesia, so standardization is essential for reproducible outcomes[12,13,23].

Operational factors merit careful control: accurate placement on the anatomically small and variable auricular target, precise patch dimensions (1 × 1 cm), and verified capsaicin content in commercial patches influence efficacy and safety; measuring local surface temperature and quantifying transdermal capsaicin penetration will strengthen dose-site interpretations[13,21].

Safety precautions are mandatory because the auricle is a sensitive site. However, no serious adverse events occurred in this cohort; protocols should include hypersensitivity screening, monitoring for local skin reactions, and participant education to avoid mucosal or ocular contact[2,5,11].

Potential therapeutic targets include disorders with autonomic dysregulation, such as GERD, where auricular stimulation has shown promise for

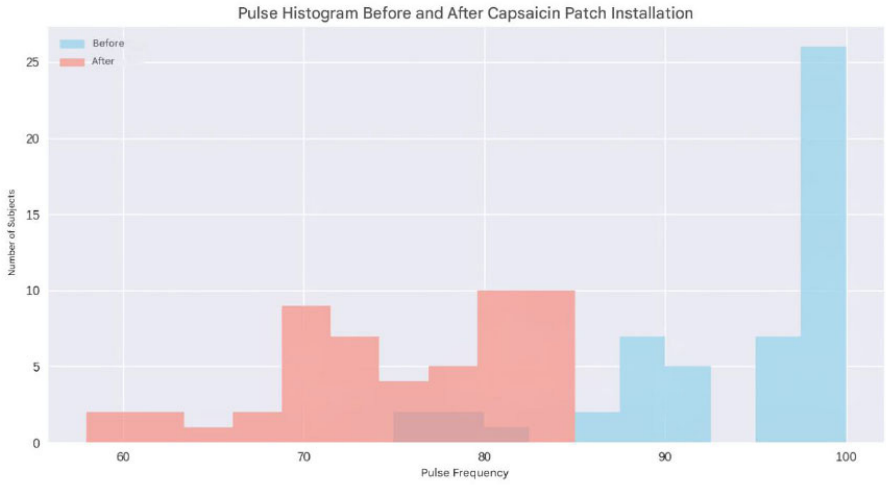

Figure 1. Pulse Histogram Before and After Capsaicin Patch Installation

improving visceral function in animal models and preliminary human studies; targeted clinical trials with functional and quality-of-life endpoints are required before therapeutic recommendations.[3,20]

To build causal and mechanistic evidence, future trials should be randomized, double-blind, and include a credible sham (e.g., non-capsaicin patch or non-vagal site application), HRV metrics, ambulatory blood pressure, inflammatory panels, and neuroimaging to map afferent activation of NTS and downstream autonomic centers[6,16,24].

In summary, this preliminary study shows that auricular capsaicin stimulation produces a marked and consistent heart rate reduction in healthy adults and is a promising, practical approach for acute neuromodulation; controlled replication, longitudinal evaluation of TRPV1-mediated desensitization, standardization of application parameters, and rigorous safety assessments are required before broader clinical translation.[2,3,18]

CONCLUSION

Application of a 1 × 1 cm capsaicin patch to the auricular area in 52 subjects resulted in a mean decrease in heart rate from 94.0 to 77.7 bpm, with a mean decrease of 16.3 bpm (SD ± 2.9). Analysis using a paired t-test showed a highly statistically significant pre- and post-intervention difference ($t = 39.4$; $df = 51$; $p < 0.0001$), and the distribution of heart rates shifted from a peak of 95–100 bpm before the intervention to 70–80 bpm after the intervention. Although baseline values varied from person to person, almost all subjects had a decrease in heart rate.

According to the results' interpretation, auricular stimulation based on capsaicin consistently produces acute autonomic modulation toward elevated parasympathetic tone, which is reflected in a drop in heart rate. No serious adverse events were reported during the observation; hypersensitivity screening protocols and skin reaction monitoring were implemented as per procedure, thus the intervention appeared to be well tolerated in the healthy population studied.

AVAILABILITY OF DATA AND MATERIALS

All data sources described in this study are directed to the corresponding author.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The research has obtained ethical approval from the Ethics Committee of the Faculty of Medicine, University of Indonesia. The ethical clearance number (KET-1394/UN2.F1/ETIK/PPM 00.02/2025) is indicative of the approval granted by the relevant ethical committee for the specified research project. All participants provided written informed consent before participation.

CONSENT FOR PUBLICATION

I, the undersigned, hereby provide my consent for the publication of identifiable information, such as figures, tables, and details within the text titled "The Effect of Capsaicin as a Vagus Auricular Nerve Stimulant in Terms of Relaxation with Pulse Rate Change Indicators," in the aforementioned Journal and Article.

CONFLICT OF INTEREST

This study has no conflicts of interest.

FUNDING

This study received no external funding.

AUTHORS' CONTRIBUTIONS

AYS contributed to Conceptualization, Data Curation, Methodology, Formal Analysis, Project Administration, Validation, Investigation, Visualization, Software, Writing – Original Draft, and Writing – Review & Editing. R.V. and DAYS contributed to Conceptualization, Project Administration, Validation, Resources, Visualization, Software, Supervision, and Writing – Review & Editing. N.P.L. contributed to Editing.

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GENERATIVE AI DISCLOSURE

The authors declare that no generative AI tools were used in the preparation or writing of this manuscript.

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