

## Transcutaneous Auricular Vagus Nerve Stimulation: A Promising Alternative Therapy for Insomnia Disorder

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### Abstract

Insomnia disorder is causing great economic burden to the society. Conventional pharmacotherapies are with multiple adverse effects to people. Auricular acupuncture (AA) inspired us to invent transcutaneous auricular vagus nerve stimulation (taVNS) years ago. We accidentally found that taVNS could improve patients sleeping conditions in depressed and in epilepsy patients. And, taVNS is with little side effect. We considered that taVNS is a promising alternative therapy for insomnia disorder with a bright future.

**Keywords:** AA: Auricular Acupuncture; taVNS: Transcutaneous Auricular Vagus Nerve Stimulation; ID: Insomnia Disorder; CAM: Complementary and Alternative Medicine

### Introduction

Insomnia disorder (ID) is a common condition that includes difficulty in initiating sleep, maintaining sleep, waking up too early, and nonrestorative or poor-quality sleep, all of which are commonly associated with symptoms of daytime functional impairment [1]. According to a WHO collaborative study in 14 countries, 16% of correspondents had difficulty falling asleep; 25% of the correspondents either experienced difficulty staying asleep or woke up too early [2]. The prevalence is even higher in the elderly and twice as high in women as in men [3,4]. Daytime complaints of people with insomnia concern cognitive functioning [5], fatigue [6], and depressed mood [6]. Moreover, insomnia leads to higher risks of depression [7], anxiety [8] and cardiovascular diseases [9]. Daytime consequences and functional impairment caused a heavy economic burden to the society [10]. It was estimated that the total annual cost of insomnia in 1994 was approximately \$30-\$35 billion in the USA [11]. Now-a-days, the number should be much higher.

Conventional approaches to the treatment of chronic insomnia usually involve either pharmacotherapies or psychological interventions. Pharmaceutical hypnotics are the primary first-line pharmacotherapy used to treat chronic insomnia [12]. The use of benzodiazepines such as diazepam and related drugs, or non-benzodiazepine hypnotics e.g. zolpidem or zopiclone are preferred currently over older barbiturates which can cause death in cases of overdose [12]. With respect to benzodiazepines, although a relatively safe class of medication, concerns exist over dependency, and currently most guidelines endorse only short-term use for insomnia. Sedating antipsychotics, such as olanzapine or quetiapine, and sedating antidepressants, including the older tricyclic drugs, are also commonly prescribed 'off label' for chronic insomnia, particularly in later life [13]. The use of these drugs has the potential to cause serious side effects [14].

Complementary and alternative medicine (CAM) now-a-days is prevalent by sufferers of psychiatric disorders, commonly for the management of depression, anxiety, or insomnia [15-17]. Most CAM therapies are with little side effects, which attract more and more people to use them. Approximately 60% reported use of CAM to their conventional medical practitioner. Younger, more educated persons were more likely to use CAM to treat their insomnia [18].

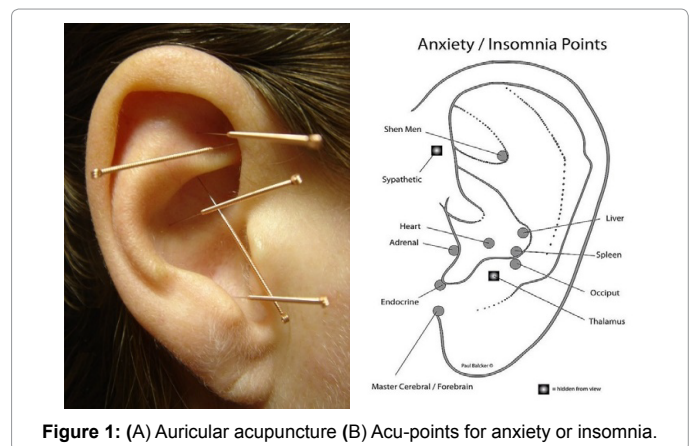


Figure 1: (A) Auricular acupuncture (B) Acu-points for anxiety or insomnia.

### Discussion

Acupuncture is an important part of CAM. Auricular acupuncture (AA) (Figure 1) is an important branch of acupuncture [19]. It is a therapeutic method by which specific points on the auricle are stimulated to treat various conditions. AA is often recommended as treatment for insomnia [20]. AA inspired us to invent transcutaneous auricular vagus nerve stimulation (taVNS) years ago. Vagus nerve stimulation (VNS) has been approved by FDA (Figure 2) for epilepsy in 1997 [21] and treatment-resistant depression in 2005 [22,23]. However, some factors limited VNS to patients, including high cost, the involvement of surgery, perioperative risks, and potentially significant side effects [24]. Based on anatomical studies which suggest that the ear is the only place on the surface of human bodies where there is afferent vagus nerve distribution [25,26], especially in the auricular concha [27]

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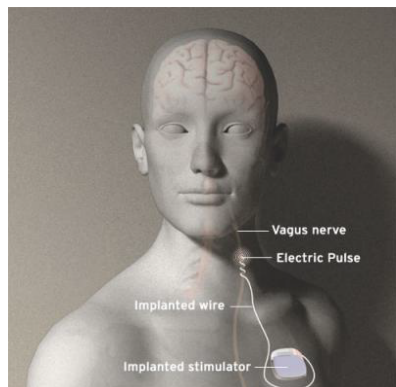


Figure 2: Vagus Nerve Stimulation (VNS).



Figure 3: The innervations of the auricular branch of the vagus nerve are marked by green color which is mainly distributed in auricular concha.

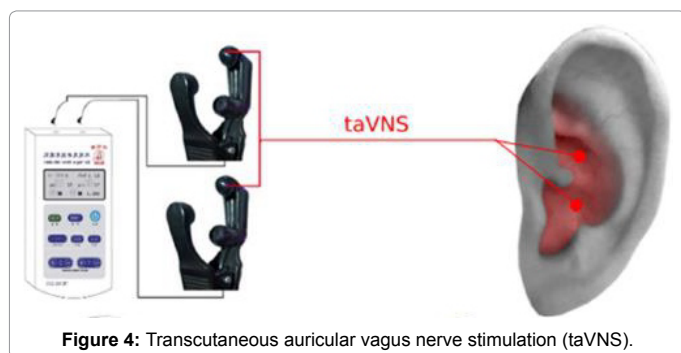


Figure 4: Transcutaneous auricular vagus nerve stimulation (taVNS).

(Figure 3), a direct current stimulation of these afferent nerve fibers superficially on ear supposes to have similar effect to classic VNS without surgical intervention [28]. In order to overcome the disadvantages of classic VNS, we developed taVNS. And we accidentally found that taVNS could improve patients sleeping conditions in depressed patients [29] and in epilepsy patients [30] during our clinical studies process. In addition, taVNS can trigger melatonin secretion, which may be one of the key mechanisms of improving sleeping conditions in patients [31].

A systematic review and meta-analysis revealed a positive effect of AA for primary insomnia [32]. Another feasibility study found that an AA insomnia regimen may improve sleep quality and daytime dysfunction among veterans with post-traumatic stress disorder [33]. Auricular points acupressure also helps increase the sleep duration and decrease wake after sleep onset [34].

However, few studies are using taVNS on insomnia disorder. So, we are collecting participants with insomnia disorder to proceed a multicenter, randomized, double-blind controlled prospective study [35]. Because of the continuous current stimulation, we considered that taVNS should have a better efficacy than AA. The result is worth looking forward to it.

## Conclusion

Overall, between 6% and 10% of adults meet the diagnostic criteria for insomnia disorder [36]. That will be approaching or exceeding 1 billion people globally, which causing great economic burden to the society. Conventional pharmacotherapies are with multiple adverse effects, which arouse the use of CAM therapies. Auricular acupuncture (AA), which is often recommended as treatment for insomnia [20], inspired us to invent transcutaneous auricular vagus nerve stimulation (taVNS) years ago (Figure 4). We accidentally found that taVNS could improve patients sleeping conditions in depressed patients [29] and in epilepsy patients [30] during our clinical studies process. We considered that taVNS is a promising alternative therapy for insomnia disorder with a bright future.

## References

1. <http://www.esstg.org/adds/ICSD.pdf>
2. Ustun T, Privett M, Lecrubier Y (1996) Form, frequency and burden of sleep problems in general health care: A report from the WHO collaborative study on psychological problems in general health care. *Eur Psychiatry* 11: 5s-10s.
3. Sivertsen B, Krokstad S, Mykletun A, Overland S (2009) Insomnia symptoms and use of health care services and medications: The HUNT-2 study. *Behav Sleep Med* 7: 210-222.
4. Ohayon MM (2002) Epidemiology of insomnia: What we know and what we still need to learn. *Sleep Med Rev* 6: 97-111.
5. Fortier-Brochu É, Beaulieu-Bonneau S, Ivers H, Morin CM (2012) Insomnia and daytime cognitive performance: A meta-analysis. *Sleep Med Rev* 16: 83-94.
6. Buysse DJ, Thompson W, Scott J (2007) Daytime symptoms in primary insomnia: A prospective analysis using ecological momentary assessment. *Sleep Med* 8: 198-208.
7. Baglioni C, Battagliese G, Feige B (2011) Insomnia as a predictor of depression: A meta-analytic evaluation of longitudinal epidemiological studies. *J Affect Disord* 135: 10-19.
8. Roth T, Roehrs T, Pies R (2007) Insomnia: Pathophysiology and implications for treatment. *Sleep Med Rev* 11: 71-79.
9. Schwartz S, Anderson WM, Cole SR, Cornoni-Huntley J, Hays JC, et al. (1999) Insomnia and heart disease: A review of epidemiologic studies. *J Psychosom Res* 47: 313-333.
10. Ozminkowski RJ, Wang S, Walsh JK (2007) The direct and indirect costs of untreated insomnia in adults in the USA. *Sleep* 30: 263.
11. Chilcott LA, Shapiro CM (1996) The socioeconomic impact of insomnia. *Pharmacoeconomics* 10: 1-14.
12. Tariq SH, Pulisetty S (2008) Pharmacotherapy for insomnia. *Clin Geriatr Med* 24: 93-105.
13. Salzman C (2008) Pharmacologic treatment of disturbed sleep in the elderly. *Harv Rev Psychiatry* 16: 271-278.
14. Papakostas GI (2008) Tolerability of modern antidepressants. *J Clin Psychiatry* 69 Suppl E1: 8-13.
15. Kessler RC, Soukup J, Davis RB (2001) The use of complementary and alternative therapies to treat anxiety and depression in the United States. *J Clin Psychiatry* 158: 289-294.
16. Elkins G, Rajab MH, Marcus J (2005) Complementary and alternative medicine use by psychiatric inpatients. *Psychol Rep* 96: 163-166.
17. Sanchez-Ortuno MM, Belanger L, Ivers H, LeBlanc M, Morin CM (2009) The use of natural products for sleep: A common practice? *Sleep Med* 10: 982-987.

18. Pearson NJ, Johnson LL, Nahin RL (2006) Insomnia, trouble sleeping, and complementary and alternative medicine: Analysis of the 2002 national health interview survey data. *Arch Intern Med* 166: 1775-1782.
19. Oleson T (2013) *Auriculotherapy manual: Chinese and western systems of ear acupuncture*: Elsevier Health Sciences.
20. Lee M, Shin BC, Suen L, Park TY, Ernst E (2008) Auricular acupuncture for insomnia: A systematic review. *Int J Clin Pract* 62: 1744-1752.
21. Ben-Menachem E (2002) Vagus-nerve stimulation for the treatment of epilepsy. *Lancet Neurol* 1: 477-482.
22. Nemeroff CB, Mayberg HS, Krahl SE (2006) VNS therapy in treatment-resistant depression: Clinical evidence and putative neurobiological mechanisms. *Neuropsychopharmacology: Official publication of the Neuropsychopharmacology* 31: 1345-1355.
23. Daban C, Martinez-Aran A, Cruz N, Vieta E (2008) Safety and efficacy of vagus nerve stimulation in treatment-resistant depression. A systematic review. *J Affect Disord* 110: 1-15.
24. Ventureyra EC (2000) Transcutaneous vagus nerve stimulation for partial onset seizure therapy. *Childs Nerv Syst* 16: 101-102.
25. Henry TR (2002) Therapeutic mechanisms of vagus nerve stimulation. *Neurology* 59: S3-14.
26. Peuker ET, Filler TJ (2002) The nerve supply of the human auricle. *Clinical Anatomy (New York NY)*; 15: 35-37.
27. He W, Wang X, Shi H (2012) Auricular acupuncture and vagal regulation. *Evidence-based complementary and alternative medicine eCAM* : 786839.
28. Rong PJ, Fang JL, Wang LP (2012) Transcutaneous vagus nerve stimulation for the treatment of depression: A study protocol for a double blinded randomized clinical trial. *BMC complementary and alternative medicine* 12: 255.
29. Fang J, Rong P, Hong Y (2016) Transcutaneous vagus nerve stimulation modulates default mode network in major depressive disorder. *Biol Psychiatry* 79: 266-273.
30. Stefan H, Kreiselmeyer G, Kerling F (2012) Transcutaneous vagus nerve stimulation (t-VNS) in pharmacoresistant epilepsies: A proof of concept trial. *Epilepsia* 53: e115-e8.
31. Li S, Zhai X, Rong P (2014) Transcutaneous auricular vagus nerve stimulation triggers melatonin secretion and is antidepressive in Zucker diabetic fatty rats. *PLoS one* 9: e111100.
32. Lan Y, Wu X, Tan HJ (2015) Auricular acupuncture with seed or pellet attachments for primary insomnia: A systematic review and meta-analysis. *BMC Complement Altern Med* 15: 1.
33. King HC, Spence DL, Hickey AH, Sargent P, Elesh R, et al. (2015) Auricular acupuncture for sleep disturbance in veterans with post-traumatic stress disorder: A feasibility study. *Mil Med* 180: 582-590.
34. Yeh CH, Suen LKP, Shen J (2016) Changes in sleep with auricular point acupressure for chronic low back pain. *Behav Sleep Med* 14: 279-294.
35. Shao-Yuan L, Yue J, Pei-Jing R, Su-Xia L, Yu-Tian Y (2016) Transcutaneous vagus nerve stimulation for the treatment of insomnia disorder: A study protocol for a double blinded randomized clinical trial. *J Clin Trials* 6: 2167-0870.1000271