ORIGINAL ARTICLE

Effects of Shen Men Auricular Acupressure on Haemodynamics during Laryngoscopy and Intubation and Preoperative Anxiety

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ABSTRACT

INTRODUCTION: Laryngoscopy and endotracheal intubation is known to cause tachycardia and increase in blood pressure during general anaesthesia. This study was designed to assess if auricular acupressure has beneficial effects in attenuating the haemodynamic changes during laryngoscopy and intubation. Secondly, this study aimed to evaluate the effectiveness of auricular acupressure in reducing preoperative anxiety. **MATERIALS AND METHODS**: Eighty patients who were scheduled for surgery under general anaesthesia were randomised to receive either active auricular acupressure over bilateral Shen Men (Group A) or sham auricular acupressure (Group B). A total of three stimulations of auricular acupressure with ten minutes interval were performed before induction of anaesthesia. Haemodynamic parameters (heart rate and blood pressure) were recorded ten minutes after each stimulation, during laryngoscopy and intubation and every minute for ten minutes after intubation. Visual analogue scale for anxiety was documented before and at 30 minutes post first stimulation. **RESULTS**: The heart rate and mean arterial pressure were statistically higher in Group B comparing to Group A during intubation ($p=0.043$ and $p=0.049$ respectively). There was statistically significant reduction in blood pressure after intubation in both groups as compared to baseline ($p<0.003$ respectively). However, there was no significant difference when comparing both groups ($p>0.05$). There was no significant reduction of preoperative anxiety level in both groups after auricular acupressure ($p=0.879$). **CONCLUSION**: Auricular acupressure over bilateral Shen Men helped to attenuate the haemodynamic changes during intubation. However, it did not reduce preoperative anxiety.

Keywords
Auricular acupressure, haemodynamic, intubation, preoperative anxiety

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INTRODUCTION

Laryngoscopy and endotracheal intubation are the most common procedures performed daily in the operating theatre. It is the gold standard technique in securing the airway especially for patients undergoing surgery under general anaesthesia (GA). However, this procedure is not without risk as it is known to cause tachycardia and increase in blood pressure.[1-2]

In 1951, King et al. illustrated this phenomenon as reflex circulatory responses to direct laryngoscopy and tracheal intubation which is due to increased cardiac sympathetic tone.[3,4] Haemodynamic changes during laryngoscopy and intubation mainly caused by mechanical irritation of the upper airway (oropharyngeal and parapharyngeal) and trachea.[3-5] The reflex cardiovascular sympathetic response is regulated by glossopharyngeal and vagus nerves.[4,6] Diffuse autonomic response occurs subsequently due to activation of cervical sympathetic efferent fibres which is also associated with increased in plasma catecholamines levels.[1,3,4,6,7] Maximum haemodynamic changes occur approximately 30-45 seconds after laryngoscopy and intubation and return to baseline within 10 minutes.[4,6]

Various pharmacological measures have been developed to prevent the stress response during this procedure, including topical anaesthesia of the upper airway, intravenous adrenergic blocking agents, alpha-2 agonists, gabapentin, opioids, lignocaine, vasodilators, intravenous and inhalational anaesthetic agents.[1-3,6] Most of them are only partially effective. Besides that, the adverse effects of the drugs are sometimes unavoidable, for example alpha-2 agonists are associated with hypotension and bradycardia.[3,6] More cost may be incurred as some of the drugs are expensive.[1,2,8] Thus, several studies were done on acupuncture points' stimulation to attenuate this stress response.[5,7,8]

Auricular acupressure is a non-invasive and less painful technique by applying pressure to specific acupoints of ears as to balance the flow of Qi.9-11 This technique can be performed by any health care providers with or without experience in Traditional Chinese Medicine (TCM).[12] Stimulation of Shen Men point is known to help tranquilise the mind, reduce stress, anxiety, insomnia and pain.[13] It is also associated with activation of parasympathetic nervous system.[14] In 1990, WHO recognised auricular acupressure as a form of micro acupuncture which is helpful in the management of several diseases.9 Many studies have shown auricular acupressure's effectiveness in the field of anaesthesia, such as improving analgesia in total knee replacement and lumbar spine surgeries, reducing postoperative nausea and vomiting (PONV) and reducing preoperative anxiety.[9-13,15]

In 2012, Wei He et al. proposed the connections between the afferent nerve from auricular branch of vagus nerve (ABVN) and nucleus of solitary tract (NST) as the basis of auricular vagal stimulation.[16] Studies have shown that heart rate and blood pressure are significantly reduced after auriculotherapy.[17-20]

Sham interventions are placebo controls that are commonly adopted in acupressure trials. The procedures refer to ineffective acupoints (sham points) which are not documented to have any therapeutic effects on established acupoint chart. [13, 21]

OBJECTIVES

This study was designed to assess if auricular acupressure has beneficial effects in attenuating the haemodynamic changes associated with laryngoscopy and tracheal intubation during GA. This study also aimed to evaluate the effectiveness of auricular acupressure in reducing preoperative anxiety.

MATERIALS AND METHODS

Study Design

This prospective, single-blind, randomised controlled study was conducted in the operating theatre of a tertiary medical centre, from June 2019 until March 2020 following approval from the Research Committee of Department of Anaesthesiology & Intensive Care and the institutional Medical Research & Ethics Committee (JEP-2018-675).

Study Population

Patients with American Society of Anaesthesiologists (ASA) class I patients, aged 18 years or older and scheduled for surgery under general anaesthesia with endotracheal intubation via direct laryngoscopy were recruited into the study. Patients with auricular abnormalities, anticipated difficult airway: Wilson Risk Sum Score greater than 2 and those with baseline heart rate less than 50 beats per minute were excluded from the study.[17,22]

Methodology

All patients who consented for the study were assessed before the surgery. They were explained on how to use visual analogue scale for anxiety (VAS-A). The VAS-A has been validated as a reliable indicator to assess preoperative anxiety. It is an anxiety measurement scale of 100 mm, with one end represents not anxious at all and the other end represents extremely anxious. A score of 50 mm and above indicates significant level of preoperative anxiety.[23,24]

The patients were randomised into two groups by using a computer-generated randomisation sequence:

1. Group A: Patients received active auricular acupressure (Shen Men).
2. Group B: Patients received sham auricular acupressure(control).

All patients were fasted for at least 6 hours, no premedication was given and scheduled to arrive at the waiting bay of operating theatre around 45 minutes prior to the surgery. Baseline haemodynamic parameters: heart rate (HR), non-invasive systolic blood pressure (SBP), diastolic blood pressure (DBP) and mean arterial pressure (MAP) were recorded with appropriate size BP cuff (Tb). Baseline VAS-A was assessed and documented (Vb).

Auricular acupressure was applied 30 minutes before induction of GA by the same operator. Active auricular acupressure over Shen Men acupoint on both ears were applied on patients in Group A (Figure 1a). Patients in Group B received sham auricular acupressure over non-acupoint areas on both ears (Figure 1b). The acupoint areas were firstly disinfected using 70% isopropyl alcohol. A 0.6 x 0.6 cm adhesive plaster with one vaccariae seed (approximately 2 mm size, smooth surface, black colour, by original equipment manufacturer from China) placed centrally was applied onto the respective points (Figure 2). Bilateral auricular acupressure was performed simultaneously with two subsequent digital pressure per second for fifteen times.[17] This process was denoted as stimulation. A total of three stimulations were performed with 10 minutes interval. Haemodynamic parameters including HR, SBP, DBP and MAP were recorded 10 minutes after each stimulation, just prior to next stimulation (T1-T3). The VAS-A was reassessed at 30

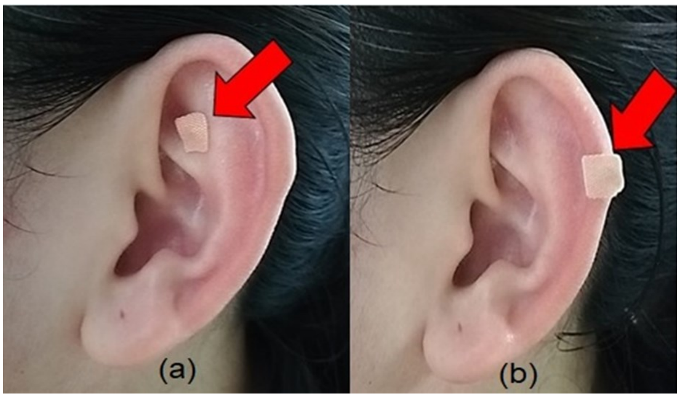


Figure 1 : **(a)** Location of Shen Men acupoint, **(b)** Location of sham acupoint.

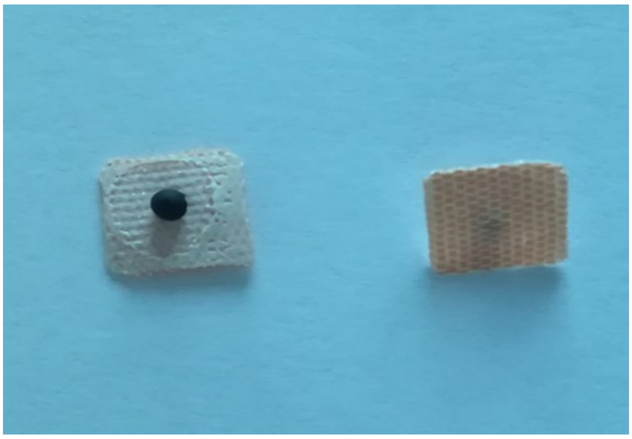


Figure 2: Vaccariae seed placed centrally on adhesive plaster (front and back)

Each patient was taken into the operation room after auricular acupressure stimulation is completed. Standard anaesthetic monitoring such as non-invasive blood pressure (NIBP), electrocardiography (ECG) and pulse oximeter were established. Haemodynamic parameters were measured and recorded prior to induction of GA (T4). All patients were preoxygenated with 100% oxygen until end tidal oxygen (ETO2)≥90%. Patients were induced with intravenous (IV) fentanyl 2 mcg/kg, and IV propofol 1% 2 mg/kg, followed by IV rocuronium 0.6 mg/kg for neuromuscular blockade. Direct laryngoscopy followed by intubation with appropriate size cuffed endotracheal tube (ETT) was performed by the attending anaesthetic medical officer after 2 minutes of mask ventilation. Haemodynamic parameters were recorded during laryngoscopy and intubation (T5). Minimum alveolar concentration (MAC) was maintained between 1.0 -1.3, using a combination of 2 to 3% sevoflurane and 50% oxygen: air mixture. Haemodynamic parameters were measured and documented every 1 minute for 10 minutes after intubation (T6-T15).[4]

Medications such as opioids, ketamine and magnesium sulphate ($MgSO_4$) which may alter haemodynamic parameters were not given during the initial 10 minutes after intubation. However, antibiotics and rescue therapy were given as indicated. During the study period, IV phenylephrine 50 mcg was given as rescue therapy when the patient's MAP was less than 20% of baseline value.

Surgical skin incisions were commenced 10 minutes post intubation. Intraoperative analgesics were given accordingly by the attending anaesthetic medical officers. The vaccariae seeds were removed from the patients 10 minutes after laryngoscopy and intubation. Adverse effects including hypotension which developed during study period were recorded.[25] Subsequent conduct of anaesthesia was carried out accordingly by the attending anaesthetic medical officer.

STATISTICAL ANALYSIS

The sample size was calculated using the 'Power and Sample Size Calculations' program. The α value was set at 0.05 and power of study at 80%. Calculations as derived from mean heart rate and standard deviation as quoted in Wang et al.[17] With consideration of the possibility of a 20% drop-out rate, total sample required was 80 patients with 40 patients per group.

Results were presented as mean±standard deviation (SD), median (interquartile range) and frequency (percentage) where appropriate. For between-group analysis, independent t-test and Mann-Whitney U test was used for parametric data (HR and VAS-A scores) and non-parametric data (SBP, DBP and MAP) respectively. For within-group analysis, repeated measures one-way analysis of variance (ANOVA) and paired t-test were used for parametric data, while Friedman's test followed by Wilcoxon signed-ranks test were used for non-parametric data. The qualitative data analysis was done by using Pearson's chi square and Fisher exact test where insufficient numbers were present. A *p* value <0.05 will be considered as statistically significant unless stated otherwise. All data analysis was performed by using SPSS version 26 for Microsoft Windows (IBM Corp, NY, USA).

RESULTS

A total of 80 patients were recruited for this study. Both Group A and B showed similar demographics distribution with regards to age, gender, body mass index (BMI) and types of surgery (Table I).

Table I: Demographic Characteristics.

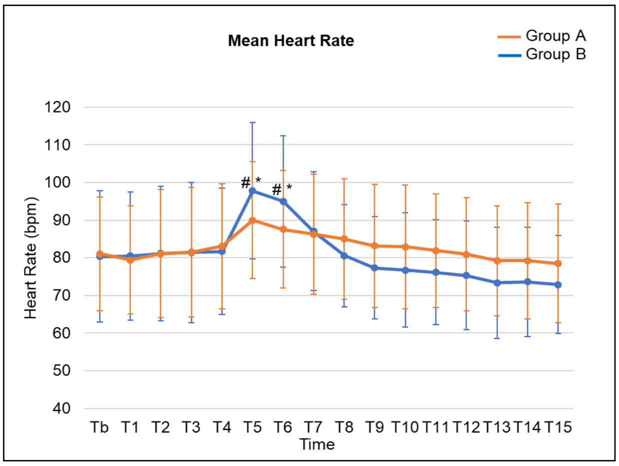
Demographic Data	Group A (n=40)	Group B (n=40)	*p* value
Age (years)	45.1±13.5	51.1±18.6	0.104
Gender			
Male	14(35.0%)	12(30.0%)	0.633
Female	26(65.0%)	28(70.0%)	
BMI (kg/m^2)	25.0±4.8	25.6±4.6	0.541
Type of Surgery			
General Surgery	13(32.5%)	16(40.0%)	
Orthopaedics	7(17.5%)	5(12.5%)	
Gynaecology	8(20.0%)	15(37.5%)	
Plastic Surgery	2(5.0%)	2(5.0%)	0.191
Otolaryngology	6(15.0%)	1(2.5%)	
Ophthalmology	1(2.5%)	0	
Dental Surgery	2(5.0%)	0	
Urology	1(2.5%)	1(2.5%)	

Data are expressed as mean ± standard deviation or frequency (percentage).

Baseline haemodynamic parameters were similar for both groups. In general, there were no significant changes in haemodynamic parameters after each auricular acupressure stimulations for both groups (T1-T4).

During intubation (T5), both groups showed increased haemodynamic parameters. Comparing both groups, HR in Group B is significantly higher than Group A (*p*=0.043) as shown in Figure 3. Group A showed increase in HR as compared to baseline, but it was not statistically significant (*p*=0.089). Group B however, showed statistically significant increment in HR (*p*<0.001) from baseline. In Group B, there was statistically significant increment in MAP (*p*=0.001), on the other hand MAP rise in Group A was not significant (*p*=0.087). Comparing both groups, MAP in Group B was significantly higher than Group A (*p*=0.049) (Figure 4). There was no statistically significant rise in SBP and DBP in both groups.

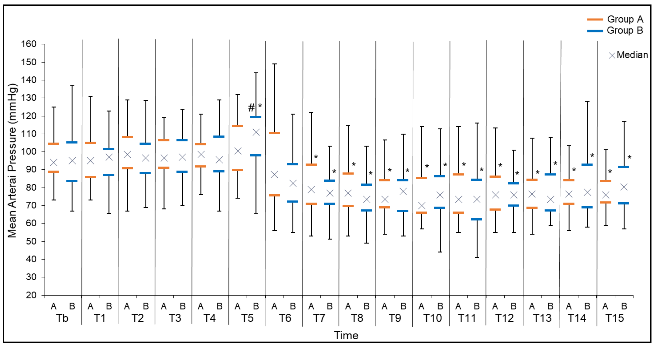
At 1-minute post intubation (T6), there was no significant rise in HR for Group A (*p*>0.05). Group B showed significant increase in HR from baseline (*p*<0.001) and as compared to Group A (*p*=0.048) (Figure 3). For Group A, there was no significant changes in SBP from baseline (*p*=0.044). Although SBP for Group B was significantly reduced (*p*<0.001) from baseline, there was no significant difference when compared to Group A (*p*=0.126). There was also no significant difference in DBP and MAP for both groups.



Vertical bars represent standard deviations (SD).
Significant *p* value (p <0.05) compared between Group A and Group B at the same measurement time (T5 and T6).
* Significant *p* value <0.05 with Bonferroni correction comparing to HR at baseline (Tb) for Group B.

Figure 3: Mean HR (beats per minute) in Group A (active) and Group B (sham) at various time intervals.

In general, after intubation, haemodynamic parameters were reduced from 2 minutes onwards (T7-T15) for both groups. But there was no significant difference in HR and blood pressure when comparing both groups (p=1.000). The reduction in HR from baseline for both groups was not statistically significant (Figure 3). Both groups showed significant reduction SBP, DBP and MAP from T7 until T15 (p<0.003) as compared to baseline (Figure 4).



Significant *p* value (p <0.05) compared between Group A and Group B at the same measurement time (T5).
* Significant *p* value <0.003 with Bonferroni correction comparing to MAP at baseline (Tb).

Figure 4: Boxplot showing median and interquartile range of MAP (mmHg) in Group A and Group B at various time intervals.

No episode of hypotension was noted before intubation in both groups. Only 1 patient in Group B required rescue therapy for hypotension during intubation (T5). After intubation (T6-T15), a total of 19 patients in Group A and 20 patients in Group B required rescue therapy for hypotension. There was statistically significant reduction in blood pressure from two minutes post intubation onwards (T7-T15) as compared to baseline in both groups (Figure 4). All patients with hypotensive episodes responded well to rescue therapy given and no major complications were reported following the hypotensive events. The incidence of hypotension which required rescue therapy in both groups did not have significant difference.

As for visual analogue scale for anxiety (VAS-A), there was no significant difference for both groups before and after acupressure stimulation. Baseline VAS-A (Vb) for Group A was 54.7±30.0 mm while for Group B was 54.5±25.6 mm (mean ± standard deviation). The VAS-A at 30 minutes post first stimulation (V30) for Group A was slightly lower than Group B, which was 55.2±28.9 mm and 56.2±28.1 mm respectively. However, the difference was not statistically significant (p=0.879).

DISCUSSION

Several studies have shown that parasympathetic nervous system is activated by stimulating certain auricular acupoints by various methods.[17-20] In our study we noted that there were no significant changes in haemodynamic readings after auricular stimulations (acupressure over bilateral Shen Men), in the active group prior to intubation.

On the contrary, previous studies have shown significant haemodynamic readings depression post auricular pressure stimulation. Gao et al. conducted a study in 14 healthy volunteers by applying auricular acupressure using vibration stimulation on auricular acupoint of Heart in 2011 which showed significant reduction in heart rate and heart rate variability after the auricular stimulation.[19] Another study done in 2012 by Chien et al., conducted on 60 middle-aged women showed significant difference in the heart rate variability between active group and control group. This suggested that auricular acupressure on auricular acupoints of liver and spleen by vaccariae seeds could inactivate sympathetic nervous system.[20] In 2013, Wang et al. performed a study in evaluating effect of auricular acupressure on Shen Men by vaccariae seeds on heart rate and heart rate variability in 31 patients with insomnia and showed significant reduction in heart rate and variability after auricular acupressure.[17] In 2016, Ana et al. demonstrated a significant decrease in systolic blood pressure after performing auricular acupressure with mustard seeds on 5 auricular points on acute cardiovascular response on 10 normotensive young adults.[18] The significant decrease in haemodynamic parameters after auriculotherapy in those studies may be due to different methods of auricular points stimulation, as well as different auricular points were stimulated.

The patients recruited in our study may have stress-induced sympathetic activation as they were scheduled for a surgery. This was supported by the significant preoperative anxiety level in our patients as both groups had VAS-A score of more than 50 mm before and after auricular acupressure.[23] We noted that application of auricular acupressure over bilateral Shen Menwas able to reduce the sympathetic response during intubation. The HR and MAP during intubation were significantly lower in the active group as compared to the sham group. Hence, we concluded that auricular acupressure could attenuate the stress response during intubation.

This is comparable to the findings in other studies which applied other acupuncture methods.[5,7,8] Ma et al. performed a similar study in which transcutaneous electrical stimulation (TEAS) on bilateral Neiguan and Quchi acupoints were applied 30 minutes before induction in 40 patients who underwent epigastric surgery. The MAP, HR and serum cortisol level were increased after intubation in both active and control groups but the rise in active group was significantly lower. They concluded that TEAS could reduce stress response caused by intubation.[5] Another study by Saleh et al. on laser stimulation of acupuncture points of Pericard 6 and Liv 3 in 20 children who underwent strabismus surgery in 2014 has revealed decrease in the haemodynamic stress response during intubation in that group of children.[7]

Several studies had shown that auricular acupressure can improve preoperative anxiety in various groups of patients.[12,15,26,27] Nevertheless, our study did not show significant reduction of anxiety level in both active and sham groups after auricular acupressure applied. This may be due to different auricular points and number of auricular points that we applied as compared to other studies. Luo et al. conducted a study which showed significant reduction in the preoperative anxiety level when applying auricular acupressure over bilateral "relaxation point" on patients undergoing gynaecological surgeries.[15] Some studies applied two or more acupressure points and demonstrated significant reduction in preoperative anxiety level.[12,26,27]

Study Limitation

We humbly admit few limitations in this study. In our study, we only applied auriculotherapy on a single acupressure point and we wouldsuggest using other auricular acupressure points in future studies. Ideally, it would have been better to include the measurement of mediators related to stress level in patients i.e. plasma catecholamine and cortisol levels which was not measured due to cost and logistic issues.

CONCLUSION

Based on the present study, we concluded that auricular acupressure over bilateral Shen Men helped to attenuate the haemodynamic changes during laryngoscopy and intubation. It did not, however, reduce preoperative anxiety.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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