Effect of Transcutaneous Electrical Nerve stimulation at the PC-5 and PC-6 acupoints on Cardiovascular physiology in Normal healthy but Sedated patients

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ABSTRACT

Background & Aims: Chinese acupuncture-based techniques are well known for pain management. But which is less established is its use for various cardiovascular symptoms. Electro acupuncture at the Neiguan (PC-6) and Jianshi (PC-5) points influences hemodynamic & prevent post spinal hypotension in c-section. This study was conducted to see the effect of transcutaneous electrical nerve stimulation (TENS) at PC-5 & PC-6 on cardiovascular physiology of normal healthy sedated patients. Methods: After obtaining approval from the local ethics committee and written informed consent, 40 persons were randomly selected & allocated into two groups (non-acupoint-A and acupoint-B) of 20 each. Vital parameters (blood pressure and pulse rate) were measured just before and 10 min after sedation and again at 15 min & 30 min after application of TENS. Acupoint groups received TENS at the PC-5 and PC-6 points of both arms and non-acupoints on both shoulders. ANOVA & Chi square test was used for statistical analysis. Results: 30% & 40% of grp B patients at 15 min & 30 min respectively developed hypertension and tachycardia. Rest did not show any cardiovascular changes or very negligible change, which might be due to augmented sympathetic tone. Conclusion: TENS at the PC-5 and PC-6 acupoints though do affect cardiovascular physiology in normal healthy but sedated patients but we need further studies in order to find the optimal frequency of TENS & some sophisticated instrument to exactly localize PC-5 & PC-6 acupressure points.

Key Words: TENS, Acupoint, Electro acupuncture

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INTRODUCTION:

Acupuncture is an important part of health care in Asian culture that can be traced back almost 3000 yr. This ancient Chinese intervention consists of applying pressure, needling, heat, and electrical stimulation at specific loci of the human body called acupoints [1] to restore patients to good health [2].
A cupoints had already been described in the earliest classic text of traditional Chinese medicine, Huangdi’s Internal Classic, written about two thousand years ago[3]. It described rules and advice for the use of the acupuncture therapy. However, the effectiveness of the acupuncture therapy and its mechanisms remain to be established scientifically. Although some previous studies tried to prove the beneficial effects of the acupuncture therapy on certain diseases [4, 5] their conclusions are not persuasive enough because they lack scientific evidence of the underlying mechanisms. Consequently, the acupuncture therapy is still hidden under a veil of mystery and yet unaccepted internationally. However, the acupuncture therapy has been developed from enormous trials and errors and performed clinically in China for several thousand years. This situation may resemble the past situation of the digitalis therapy for congestive heart failure. Namely, digitalis has been used empirically but effectively for about two hundred years without definite scientific evidence until its validity was recently proved scientifically [6, 7]. Thus, it seems meaningful to evaluate the efficacy of the acupuncture therapy by using scientifically sound methods and concepts. Among many acupoints, we were interested in the Neiguan (PC-6) acupoint, because it has been considered to affect the cardiovascular system [8]. A previous clinical study in China showed that acupuncture could raise blood pressure and had a therapeutic effect on shock [9]. However, the mechanism of the pressor effect of Neiguan EA on hemorrhagic hypotension remained still unclear.

So this study was conducted to see the effect of transcutaneous electrical nerve stimulation (TENS) at the PC-5 and PC-6 acupoints on cardiovascular physiology in normal healthy but sedated persons.

MATERIALS & METHODS

After obtaining approval from the institutional ethics committee and written informed patient consent, 40 ASA I patients in the age group of 20 to 60 yrs and weighing 40 to 80 kg, who were posted for elective mastoidectomy was enrolled in this randomized study. It is a single blind pilot study which was performed at Dept of Otorhinolaryngology. The study was conducted over a period of one year.

Excluding criteria’s:

- Patients with previous experience of acupuncture or acu-stimulation
- Patients having implanted pacemaker or defibrillator device
- Patients with H/O diabetes, hypertension or with other neurodegenerative disease
- H/O any other cardiovascular, respiratory or neurological disease
- Patients with Contact dermatitis or any skin disease
- Pregnant ladies
- Those with BMI.30 kg/m2 (Obese)

Patients were randomized into two groups, using computer-generated sealed envelopes (Group A and Group B). Gr-A is the non-acupoint group received TENS at Non-acupoints of both shoulders [10] (Fig. 1) on two points randomly selected in shoulder (on the belly or deltoid). Gr-B received TENS at the PC-5 and PC-6 points (on the ventral side of both arms, between the tendons of Palmaris longus & Flexor Carpi radialis [11] along the Pericardium Meridian) (Fig-2). PC-6 is at one-sixth of the distance between the distal transverse wrist crease and the antecubital crease, along the course of the median nerve or 2 inches up to wrist bracelet, 0.5 - 1.0 deep & 1
inch above that (PC-5). On arrival in the operation room, all patients had standard monitoring in place (non-invasive blood pressure, ECG, and pulse oximetry) and 5 min later, the baseline values were recorded in the supine position. Then after setting an IV line, 0.05 mg/kg Midazolam IV was administered in the acupoint and non-acupoint groups, small-sized (1.5 cm) cutaneous electrode pads were placed bilaterally at the PC-6 and PC-5 points and non-acupoints of the shoulders, respectively. Again vitals were measured 10 min after that when the patient was sedated and then TENS was applied for 30 minutes in both the groups. Vitals were measured at 15 min & 30 min. The intensity of the electrical stimulation was adjusted to produce the most intense tolerable electrical sensation without muscle contractions or uncomfortable feelings. TENS was producing “Asymmetrical Biphasic Square Wave” (Fig 3), so the Pulse Width (100-250µs) was set at 150µs & Pulse Rate (1-150 Hz) was set at 50 Hz and the Output Voltage (110Vp) was set at 10V (Fig-4).

Fig 1 The locations of small-sized cutaneous electrode pads for TENS

Fig 2 Position of PC-5 & PC-6 along Pericardium meridian
A sample size of 20 patients per group was calculated to detect a significant difference of 10% or more in vital parameters with a power of 80% and a significance level of 5%. All variables were tested for normal distribution by the chi square test. Descriptive statistics are expressed as mean±(SD) unless otherwise stated. Student’s t-test was used for comparison of the means of continuous variables and normally distributed data. Two-way analysis of variance (ANOVA) was used for variable differences in groups. Discrete data was analyzed with the Chi square test. Statistical significance was defined as P<0.05.
RESULTS

The study was performed with a total of 40 randomly selected patients keeping an eye on the eligibility criteria (excluding those who failed to meet the inclusion criteria and those patients who refused participation) between 1st January, 2008 and 1st June, 2009.

The groups were comparable with respect to age, body weight, height, ASA physical status, and duration of surgery (table 1).

**Table 1: Demographic profile**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Grp A (20)</th>
<th>Grp B(20)</th>
<th>‘P’ Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yrs)</td>
<td>50</td>
<td>52</td>
<td>NS</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>77</td>
<td>75</td>
<td>NS</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>168</td>
<td>166</td>
<td>NS</td>
</tr>
<tr>
<td>ASA Status</td>
<td>Gr I (20)</td>
<td>Gr I (20)</td>
<td>NS</td>
</tr>
<tr>
<td>Type of Operation</td>
<td>MRM</td>
<td>MRM</td>
<td>NS</td>
</tr>
</tbody>
</table>

15 min after application of TENS in Gr-A only three patients developed increase in BP (Highest BP 146/76 mm Hg i.e. mean BP increased by 15%) which was non significant and there was no tachycardia (table 2).

**Table 2: Effect of Transcutaneous Electrical Nerve stimulation at the PC-5 and PC-6 acupoints on cardiovascular physiology after administration of Midazolam**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Gr-A/Non-Acupoint(n=20)</th>
<th>Gr-B/Acupoint (n=20)</th>
<th>p-value(&lt;0.05) Significant/Non Significant</th>
</tr>
</thead>
<tbody>
<tr>
<td>SBP in mm Hg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>after 10 min (Baseline)</td>
<td>121</td>
<td>123</td>
<td>-</td>
</tr>
<tr>
<td>at 15 min (Highest)</td>
<td>146</td>
<td>164</td>
<td>A= NS</td>
</tr>
<tr>
<td>at 30 min (Highest)</td>
<td>142</td>
<td>184 (40%)</td>
<td>A=NS</td>
</tr>
<tr>
<td>DBP (mm Hg)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>after 10 min (Baseline)</td>
<td>78</td>
<td>80</td>
<td>-</td>
</tr>
<tr>
<td>at 15 min (Highest)</td>
<td>76</td>
<td>102</td>
<td>A=NS</td>
</tr>
<tr>
<td>at 30 min (Highest)</td>
<td>76</td>
<td>110</td>
<td>A=NS</td>
</tr>
<tr>
<td>Baseline mean (mm Hg)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>after 10 min (Baseline)</td>
<td>92</td>
<td>94</td>
<td>-</td>
</tr>
<tr>
<td>at 15 min (Highest)</td>
<td>105.8 (↑15%)</td>
<td>114.68 (↑22%)</td>
<td>A=NS</td>
</tr>
<tr>
<td>at 30 min (Highest)</td>
<td>104.88 (↑14%)</td>
<td>126.90 (↑35%)</td>
<td>A=NS</td>
</tr>
<tr>
<td>Baseline</td>
<td>after 10 min (Baseline)</td>
<td>84</td>
<td>81</td>
</tr>
</tbody>
</table>
In Gr-B only six patients (30%) developed increase in BP (Highest BP: 164/102 mm Hg i.e. mean BP increased by 22%). In rest 70% patients in Gr-B, mean BP was 132/72 mm Hg. The increase in BP was significant and 50% patients develop Tachycardia (>100bmp) (table 2).

30 Min after application of TENS, there was almost no change in Group A. In Gr-B only 8 pts (40%) developed an increase in blood pressure (Highest BP was 184/110 i.e. mean BP increased by 35%). The increase in BP was significant and 50% patients developed tachycardia (>130 bmp) (table 2).

**DISCUSSION**

The present study showed that TENS increases hemodynamic response to some extent, but not in all the members.

“Prevention is always better than treatment of illnesses”, is what the traditional Chinese acupuncture believes in. Its philosophy presumes that there are two opposing and complementary forces that coexist in nature. These two forces interact to regulate the flow of “vital energy”. When a person is in “good health,” they are in balance, and the flow of vital energy is smooth and regular. When they become “unbalanced,” there are disturbances in vital energy, which lead to illness and disease. The ancient Chinese believed that the vital energy flows through a network of channels called meridians, which brings it from the internal organs to the skin surface. Along these meridians there are acupuncture points that can be stimulated to correct the imbalance and restore the body to normal health [2]. In the present study TENS was used to stimulate these points as it is also known as "Electronic Aspirin", a machine which sends tiny electrical impulses, so is known as electroacupuncture.

Chinese acupuncture-based techniques have already been used for perioperative management of anxiety [12] postoperative nausea and vomiting [11] and postoperative analgesia [13]. In animal studies, electroacupuncture at the Neiguan (PC-6) and Jianshi (PC-5) points influences vascular pressure responses and the cardiovascular sympathetic system[14,15] and especially electroacupuncture at the PC-6 point increases cardiovascular variables such as stroke volume and cardiac output and alleviates hemorrhagic hypotension[16,17]. Arai et al proved that Transcutaneous electrical nerve stimulation at the PC-5 and PC-6 acupoints reduced the severity of hypotension after spinal anaesthesia in patients undergoing Caesarean section [18]. Electroacupuncture at an acupuncture point (PC-6) is known to influence hemodynamic and cardiovascular sympathoexcitatory responses [10, 18, 19, and 20] and is known to increase stroke volume and cardiac output, and alleviate hemorrhagic hypotension [16, 17]. Neiguan EA improves suppressed LV performance by an improved venous filling and recovers the reduced blood pressure during hemorrhagic hypotension. The mechanism of this anti-hypotension effect of Neiguan EA seems to be due to an increased venous return by augmented vasomotor and venoconstrictor tone under a certain level of skeletal muscle contraction [21]. However, their physiological mechanisms are not yet elucidated.
Thus, the purpose of the present study was to test the effect of TENS at the PC-6 and PC-5 points on hemodynamic in normal but sedated patients.

In the present study, TENS was delivered at the most intense tolerable electrical sensation, and it would not be surprising if TENS itself had some sympathomimetic effect, as shown in the non-acupoint group. (Gr A)

An electrical stimulation of somatic afferents from muscle at 40 Hz causes a pressor response (Gr A)[22]. Electroacupuncture at the PC-6 point also augments sympathetic tone and improves the inhibited cardiovascular function [16, 17]. PC-6 and PC-5 points might have augmented sympathetic tone, thereby increasing cardiac function and vascular tone. When giving the same level of electrical stimulation, at the specific acupoints the increase in blood pressure was significant compared with TENS at the non-specific points. But maximum 40% patients developed hypertension, what about the rest 60%?? Might be 1) Incorrect position 2) Inadequate strength of current or 3) Patient was less sensitive.

CONCLUSION:
Transcutaneous electrical nerve stimulation at the PC-5 and PC-6 acupoints though do affect cardiovascular physiology in normal healthy but sedated patients but we need further studies in order to find the optimal frequency of TENS. We need some sophisticated instrument to exactly localize PC-5 & PC-6 acupressure points.

REFERENCE