Effect of acupuncture on bronchial asthma

D. Y. C. Yu and S. P. Lee
Department of Medicine, University of Hong Kong, Queen Mary Hospital, Hong Kong

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Summary
1. Needle acupuncture was performed at three sites in twenty patients in a clinical attack of bronchial asthma.
2. In all patients the symptoms of bronchoconstriction improved during the attacks when the correct site was stimulated, and in five patients wheezing was abolished.
3. Stimulation at the correct site produced a significant increase in the mean FEV₁₀ (58%) and FVC (29%) but not in maximal mid-expiratory flow rate (MMFR; 76%), when compared with the findings before acupuncture, along with a significant fall in the Pa₂CO₂ and an insignificant fall in Pa₂O₂. A mild tachycardia was also observed.
4. After acupuncture a greater improvement in FEV₁₀, FVC and MMFR was produced by inhalation of isoprenaline.
5. No significant changes in FEV₁₀, FVC, MMFR, pulse rate or arterial blood gas tensions occurred after acupuncture at control sites.
6. In four of the patients during clinical remission acupuncture was performed before and after histamine aerosol challenge, but there was no effect on either the severity or the duration of the histamine-induced bronchoconstriction.
7. It is concluded that acupuncture probably reduced the reflex component of the bronchoconstriction, but failed to influence direct smooth muscle constriction caused by histamine.

Key words: acupuncture, asthma, histamine.

Introduction
It is claimed that acupuncture has been employed as a therapeutic measure in China since 400 B.C. (Huang Ti Nei Jing, 1972), but now it has assumed a remarkable prominence. Reports in the Chinese medical literature describe the successful treatment of asthma by puncturing specific points (Lee, 1958; Lu, 1957; Chan & Ho, 1959), with relief of symptoms and abolition of signs of asthmatic attacks. Objective improvement in forced expiratory volume in 1 s (FEV₁₀) and peak expiratory flow rate after acupuncture and electrostimulation had been reported in six patients in status asthmaticus (Wen & Chau, 1973). Previous reports have not attempted to define whether the subjective or objective improvements were due to a non-specific effect of acupuncture alone or due to electrostimulation. We describe the functional changes associated with acupuncture at only one site in comparison with those following stimulation at another site which is alleged to be specific for other organs. The effect of acupuncture on the bronchoconstriction induced by histamine in asthmatic patients is also reported.

Materials and methods
Acupuncture in clinical asthmatic attacks
We studied twenty patients admitted to the University Department of Medicine, Queen Mary Hospital, Hong Kong during an acute attack of asthma. They were divided into two groups of ten. Group 1 received acupuncture at a site specific for asthma and group 2 served as control. The clinical
Clinical features of patients studied

<table>
<thead>
<tr>
<th>No.</th>
<th>Sex</th>
<th>Age (years)</th>
<th>Height (m)</th>
<th>Initial FEV(_1.0) (%) of predicted</th>
<th>Duration of asthma (years)</th>
<th>History of steroid therapy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F</td>
<td>21</td>
<td>1.58</td>
<td>16</td>
<td>7</td>
<td>—</td>
</tr>
<tr>
<td>2</td>
<td>M</td>
<td>53</td>
<td>1.74</td>
<td>40</td>
<td>30</td>
<td>+</td>
</tr>
<tr>
<td>3</td>
<td>M</td>
<td>45</td>
<td>1.60</td>
<td>45</td>
<td>27</td>
<td>+</td>
</tr>
<tr>
<td>4</td>
<td>M</td>
<td>65</td>
<td>1.68</td>
<td>28</td>
<td>20</td>
<td>+</td>
</tr>
<tr>
<td>5</td>
<td>M</td>
<td>63</td>
<td>1.73</td>
<td>25</td>
<td>40</td>
<td>+</td>
</tr>
<tr>
<td>6</td>
<td>M</td>
<td>47</td>
<td>1.71</td>
<td>35</td>
<td>26</td>
<td>—</td>
</tr>
<tr>
<td>7</td>
<td>M</td>
<td>17</td>
<td>1.76</td>
<td>24</td>
<td>12</td>
<td>+</td>
</tr>
<tr>
<td>8</td>
<td>M</td>
<td>56</td>
<td>1.71</td>
<td>31</td>
<td>40</td>
<td>+</td>
</tr>
<tr>
<td>9</td>
<td>F</td>
<td>33</td>
<td>1.63</td>
<td>37</td>
<td>20</td>
<td>—</td>
</tr>
<tr>
<td>10</td>
<td>F</td>
<td>15</td>
<td>1.60</td>
<td>47</td>
<td>7</td>
<td>—</td>
</tr>
</tbody>
</table>

Mean±SEM: Group 1: 41.5±6.0 1.67±0.02 32.8±3.1 23±4

Mean±SEM: Group 2: 46.7±3.3 1.64±0.02 37.4±4.1 23±4

(*) Predicted values are taken from Da Costa (1971).

Features are summarized in Table 1, asthma being diagnosed from a history of paroxysmal attacks of breathlessness with wheezing, blood eosinophilia, absence of chest X-ray abnormality (apart from hyperinflation), normal single-breath carbon monoxide transfer factor, together with a return of FEV\(_1.0\) to approximately normal, and maximal mid-expiratory flow rate (MMFR) to near-normal values after intensive bronchodilator therapy with or without the use of steroids. All the patients gave informed consent to the study, and none had ever experienced acupuncture before. Possible effects of this treatment were not suggested. No patient received bronchodilators or steroid preparations for at least 5 h before the study.

Forced vital capacity (FVC) measurements were recorded in sets of three with a spirometer (Godart Pulmotest) at a paper speed of 1200 mm/min. In patients nos. 1–10 (group 1), arterial blood pressure was measured continuously by a pressure transducer (Hewlett Packard S1280), from a cannula in the brachial artery. The blood pressure and electrocardiograms (ECG) were recorded by a Honeywell multichannel recorder (model 2106). Serial arterial blood samples were analysed for Pa\(_{o2}\) and pH (Radiometer electrodes), Pa\(_{co2}\) being derived by the interpolation technique.

It has been reported that the correct positioning of the acupuncture point produces a specific pattern of paraesthesia, hypoaesthesia or anaesthesia (Lee, 1971). The production of this pattern is considered to be prerequisite to effective acupuncture (Shanghai Institute of Acupuncture Research, 1972). Three acupuncture sites were selected for testing. Autoclaved standard silver alloy acupuncture needles (5 cm long, 0.2 mm diameter) were used throughout the experiments. The needles were inserted aseptically without local anaesthesia. The 'Tsu San Li' of the right leg, designated as site 1, was chosen as this is a classical acupuncture point used chiefly for the relief of abdominal colic (Lee, 1958b). This site was located by puncturing perpendicular to the skin to a depth of 3–4 cm at a point 3 cm posterior and lateral to the inferior border of the tibial tubercle, traversing the tibialis anterior to the vicinity of the interosseous septum. Position of the needle was considered to be correct when local numbness, distension or paraesthesia developed over the dorsum of the foot.
The ‘Din Chuan’ on both sides, designated as site 2a, was selected because this is regarded to be among the specific points for asthma. This site (2a) was located by inserting the acupuncture needle 3 cm lateral to the mid-point between C7 and T1 spinous processes, directed medially approximately 4 cm deep, to a point just superficial to the junction between the lamina and the transverse process of the T1 vertebra. Positioning of the needle was considered to be correct when a sensation of numbness, distension or paraesthesia radiated down both sides of the spine. A control site on both sides, designated as site 2b, was taken 4 cm lateral to site 2a with puncture to the same depth. Puncture of this site either produced a paraesthesia over the shoulders or no abnormal sensation. The acupuncture sites were stimulated manually by continuous clockwise and anticlockwise rotation of the needles at a rate of 1 cycle/s and the needles were withdrawn after a period of 10 min.

In patients nos. 1–10 (group 1), acupuncture was first applied at site 1 and then at site 2a for a period of 10 min each. In patients nos. 11–20 (group 2), the procedure was similar but site 2b was used in place of site 2a. At the end of the period of observation all patients inhaled three vital-capacity breaths of 1% isoprenaline aerosol delivered by a Bird micro-nebulizer operated by compressed air at a flow rate of 8 l/min. Measurements were taken before and after acupuncture at site 1, immediately and 10 min after acupuncture at site 2 (a or b) and 5 min after isoprenaline inhalation. Possible implications of the effect of acupuncture at the various sites was neither conveyed nor suggested to the patients.

**Acupuncture in induced bronchoconstriction by histamine**

Four volunteer patients with asthma were studied while in clinical remission. A dose–response to histamine acid phosphate aerosol was determined, commencing with a concentration of 0.03 μmol/l

![Fig. 1. Change in (a) FEV₁₋₀ (l), (b) FVC (l) and (c) MMFR (l/s) before and after acupuncture at control site 1 (specific for abdominal colic), at experimental site 2a (specific for asthma) and isoprenaline aerosol in group 1 patients (○), compared with acupuncture at control site 1 and then site 2b (located 4 cm lateral to site 2a), and isoprenaline aerosol in group 2 patients (●). Mean values ± SD are indicated.](image-url)
administered for 1 min by a Bird Micronebulizer at a flow rate of 8 l/min. The concentration which produced a fall in FEV$_1$ of 30-40% from control values was chosen for the subsequent challenge dose, which ranged from 3.3 to 32.6 µmol/l. Sodium chloride solution (150 mmol/l) aerosol was used as a control. The FEV$_1$, and FVC were measured before and 1, 3, 5, 10 and 20 min after inhalation.

Acupuncture at site 2a was carried out for 10 min immediately after histamine aerosol challenge, and 1 h later acupuncture at the same site was administered for 10 min immediately before histamine challenge to study whether the bronchoconstriction could be blocked. Twenty-four hours later, control tests and the testing dose of histamine acid phosphate were repeated to ascertain the reproducibility of results.

Statistical comparisons were made by unpaired t-test between group 1 and group 2 patients (Snedecor & Cochrane, 1967).

**Results**

**Acupuncture in clinical asthmatic attacks**

*Clinical response.* No subjective improvement was reported by nine of the ten patients in group 1 or by any of the patients in group 2 after puncture at site 1. The exception reported partial relief of the dyspnoea.

Nine patients in group 1 had subjective improvement of the breathlessness after puncture at site 2a. In five of these the expiratory wheeze decreased objectively, and completely disappeared in the others, patients nos. 1, 3, 6, 9 and 10. One patient (no. 6) developed a vaso-vagal attack during puncture at the experimental site. Five patients in group 2 noticed subjective improvement, with decreased wheeze in patients nos. 13, 15 and 19.

*Respiratory responses.* There were significant increases in FEV$_1$, (0.05 >P>0.025), and FVC (0.05 >P>0.025), but not in MMFR after stimulation at site 2a, but not after stimulation at site 1 or site 2b (Fig. 1). The improvement was insignificant in those patients who showed a poor response to inhalation of isoprenaline and all patients improved further after isoprenaline. (Data for individual patients are included in *Clinical Science and Molecular Medicine* Table 76/6 deposited with the Librarian of the Royal Society of Medicine, 1 Wimpole Street, London W1M 8AE, from whom copies may be obtained on request.)

*Effect on blood pressure, heart rate and arterial blood gas tensions in group 1 patients.* There was a

| TABLE 2. Effect of acupuncture on blood pressure, heart rate and arterial blood gas tensions |
|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|
| Mean values ± sd are shown (n = 10). * Results differ significantly (P<0.05) from control values. |
| Control | Acupuncture at site 1 | Acupuncture at site 2a | Isoprenaline |
| Blood pressure (mmHg) | 126±22/72±13 | 116±22/65±9* | 118±25/71±13 | 118±22/69±6 |
| Heart rate (beats/min) | 87±13 | 90±16 | 100±13* | 107±22* |
| $P_{a,0_2}$ (kPa) | 11.4±1.5 | 11.2±1.7 | 10.9±1.8 | 11.4±2.2 |
| $P_{a, C0_2}$ (kPa) | 4.9±0.6 | 5.0±0.6 | 4.1±0.4* | 4.2±0.4* |
| pH | 7.36±0.06 | 7.37±0.06 | 7.38±0.09 | 7.40±0.09 |

![Fig. 2. Change in $P_{a,0_2}$ (●) and $P_{a, C0_2}$ (●) before and after acupuncture at control site 1 (specific for abdominal colic) and site 2a (specific for asthma) and after isoprenaline aerosol in group 1 patients.](image-url)
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Time (min)

FIG. 3. Effect of acupuncture on bronchoconstriction induced by inhalation of histamine acid phosphate aerosol. Results indicate mean ± SEM of the change (%) in FEV₁₋₀ from control values: ○, acupuncture before inhalation; ■, acupuncture after inhalation. The stippled area indicates the effect of the inhalation on FEV₁₋₀.

small reduction in blood pressure after stimulation at site 1, and a small increase in heart rate after stimulation at site 2a (Table 2, Fig. 2). In five patients there was a fall in PaₐO₂ after acupuncture to site 2a, with a concomitant fall in PaₐCO₂. When all ten patients were analysed, the fall in PaₐCO₂ was statistically significant, but the fall in PaₐO₂ was not. The arterial blood gas tensions showed no further significant change after isoprenaline inhalation. There was no correlation between the basal PaₐO₂ value and the change in PaₐO₂ after acupuncture or isoprenaline inhalation.

Acupuncture and induced bronchoconstriction

When histamine aerosol was inhaled in the predetermined concentration there was an immediate decrease in FEV₁₋₀ by 30–40% lasting 15–20 min. The time-course of this decrease in FEV₁₋₀ was not altered by acupuncture carried out either before or after the histamine challenge (Fig. 3).

Discussion

Asthma is a disease with highly variable and unpredictable course which can be strongly influenced simply by suggestion alone. Although subjective and clinical improvement have been recorded after acupuncture (Lee, 1958a; Lu, 1957), subjective symptoms are difficult to interpret and relief of audible wheezing can be due to reduction in air flow despite no change, or even an increase, in airway obstruction. Improvement in FEV₁₋₀ after electrostimulation via acupuncture needles applied to the ears has been reported (Wen & Chau, 1973). However, in that study the lack of control sites and the use of prolonged stimulation renders interpretation difficult. In the present study, acute experiments were chosen to minimize the effect of natural variability of bronchoconstriction with time. A control point (site 1) was used because an abnormal sensation could be provoked at this site and it is regarded as one of the classical acupuncture points. This site suffered from its location being away from the chest. Therefore a second control point (site 2b) was used, located in the chest. This control site again was not ideal because an abnormal sensation could not be obtained in every subject studied. Since the effect of increase in FEV₁₋₀ after acupuncture lasts more than 6 h (Wen & Chau, 1973), it would be difficult to interpret the results of a randomized sequence of stimulation to the control and experimental sites. Two groups of patients with similar basal air-flow obstruction and similar responses to isoprenaline were used mainly to determine whether the effect produced by stimulation of site 2a could be due to a delayed effect of stimulation of
site 1. Although the patients had not previously experienced acupuncture in any form, and had no prior knowledge of the response to acupuncture at any site, they could not have avoided reading or hearing of the reputed virtues of acupuncture from the media of mass communication. Despite these limitations, this study showed a significant increase in FEV₁₀ and FVC after acupuncture at site 2a as opposed to that after stimulation of either of the two control sites (site 1 or site 2b). It is difficult to ascribe the findings in the present study to suggestion alone and we conclude that the reduction in airway obstruction produced was attributable directly to the stimulation of site 2a, the 'Din Chuan' point.

In five patients there was a fall in \( Pa_{CO_2} \) despite an overall increase in alveolar ventilation, shown by the fall in \( Pa_{CO_2} \) which was associated with an improvement in FEV₁₀ after acupuncture at site 2a. This suggests that the ventilation-perfusion relationships in the lung were considerably altered at the time that the bronchoconstriction was partially relieved. This phenomenon has been reported after the administration of isoprenaline or aminophylline in asthma (Pain & Read, 1963; Tai & Read, 1967; Field, 1967), and these blood gas changes after acupuncture may result from the same mechanism as do those observed after bronchodilators.

The bronchodilatation after acupuncture was not as great as that after isoprenaline inhalation. In the traditional treatment of asthma by acupuncture, the 'Din Chuan' (site 2a) is only one of the several sites (Lee, Tsai, Yen & Chen, 1958), which may be stimulated simultaneously, manually, electrically or by application of heat to the acupuncture needles for 10–30 min. It could be argued that in the present investigation the sole use of one site and the restriction to manual stimulation for 10 min failed to achieve the maximum effect. However, acupuncture did not modify histamine-induced bronchoconstriction, whether applied before or after the histamine challenge. This suggests that acupuncture can at best only relieve that part of the bronchoconstriction which does not arise from constriction of smooth muscle as a result of chemical mediators.

Non-specific stimuli involving the parasympathetic nervous pathway can produce bronchoconstriction in both man and experimental animals (DuBois & Dantrebande, 1958; Nadel & Comroe, 1961; Nadel & Widdicombe, 1962; Lloyd, 1963; Sterling & Batten, 1969). This reflex bronchoconstriction is enhanced in asthma (Curry, 1947; Simmonsson, Jacobs & Nadel, 1967; Cade & Pain, 1971). Antigen-induced bronchoconstriction in sensitized animals can also be mediated through the parasympathetic system (Karczewski, 1962; Karczewski & Widdicombe, 1969). In asthmatic patients, antigen-induced bronchoconstriction has also been shown to have a reflex component, which is reversible by atropine (Yu, Galant & Gold, 1972). Furthermore, antigen challenge to one lung in sensitized dogs produced bilateral bronchoconstriction, which could be abolished by either bilateral vagal block, or by block of the vagus nerve from the challenged lung alone, thereby indicating the importance of the reflex pathway in antigen-induced bronchoconstriction (Gold, Kessler & Yu, 1972). The effect of acupuncture in asthma may be mediated through modification of the reflex component of bronchoconstriction. This could account for its inefficiency when compared with isoprenaline inhalation and its failure to block histamine-induced bronchoconstriction. However, the effect of suggestion, although remote, cannot be entirely ruled out.

Acknowledgment

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References


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