Effect of two breathing exercises (Buteyko and pranayama) in asthma: a randomised controlled trial

S Cooper, J Oborne, S Newton, V Harrison, J Thompson Coon, S Lewis, A Tattersfield

Background: Patients with asthma are interested in the use of breathing exercises but their role is uncertain. The effects of the Buteyko breathing technique, a device which mimics pranayama (a yoga breathing technique), and a dummy pranayama device on bronchial responsiveness and symptoms were compared over 6 months in a parallel group study.

Methods: Ninety patients with asthma taking an inhaled corticosteroid were randomised after a 2 week run in period to Eucapnic Buteyko breathing, using a Pink City Lung Exerciser (PCLE) to mimic pranayama, or a PCLE placebo device. Subjects practised the techniques at home twice daily for 6 months followed by an optional steroid reduction phase. Primary outcome measures were symptom scores and change in the dose of methacholine provoking a 20% fall in FEV₁ (PD₂₀) during the first 6 months.

Results: Sixty nine patients (78%) completed the study. There was no significant difference in PD₂₀ between the three groups at 3 or 6 months. Symptoms remained relatively stable in the PCLE and placebo groups but were reduced in the Buteyko group. Median change in symptom scores at 6 months was 0 (interquartile range –1 to 1) in the placebo group, –1 (–2 to 0.75) in the PCLE group, and –3 (–4 to 0) in the Buteyko group (p=0.003 for difference between groups). Bronchodilator use was reduced in the Buteyko group by two puffs/day at 6 months; there was no change in the other two groups (p=0.005). No difference was seen between the groups in FEV₁, exacerbations, or ability to reduce inhaled corticosteroids.

Conclusion: The Buteyko breathing technique can improve symptoms and reduce bronchodilator use but does not appear to change bronchial responsiveness or lung function in patients with asthma. No benefit was shown for the Pink City Lung Exerciser.

There is interest in the use of complementary treatment for asthma and a third of respondents in a recent asthma survey had tried one or more breathing techniques to relieve symptoms. However, few controlled studies have been undertaken to determine the effectiveness of these approaches. We have previously studied two components of pranayama, the yoga breathing exercise, by asking subjects with asthma to breathe twice a day through a cylinder with an expiratory resistance (the Pink City Lung Exerciser (PCLE)) designed to reduce breathing frequency and increase the duration of expiration. There was a small reduction in airway responsiveness to histamine after using the PCLE for 2 weeks compared with a placebo device without a resistance.

A BBC television programme in 1998 generated considerable interest in the Buteyko breathing technique. The technique, developed in Russia by Konstantin Buteyko, is based on the belief that asthma is caused by hyperventilation and hypocapnia and can be cured in most patients by using special techniques to reduce minute ventilation. The effects on asthma control in two small controlled studies in Australia were modest, however. The Eucapnic Buteyko method is an adaptation of the Russian technique which was first introduced in Australia but is now used worldwide. It includes special techniques to reduce minute ventilation.

We compared the effect of the Buteyko technique, pranayama exercises using the PCLE, and the PCLE placebo device in subjects with asthma. Symptom scores and bronchial responsiveness to methacholine were the primary outcome measures.

METHODS

Subjects

Non-smoking volunteers aged 18–70 with stable asthma but no other important illness were recruited between September 1999 and November 2000 from our asthma volunteer database and from posters and newspaper advertisements. Inclusion criteria included: taking an inhaled short acting β₂ agonist at least twice a week and regular inhaled corticosteroids with no change in dose in the preceding 4 weeks; pre-bronchodilator forced expiratory volume in 1 second (FEV₁) of at least 50% predicted and a 10% increase following 400 µg inhaled salbutamol; a provocative dose of methacholine causing a 20% fall in FEV₁ (PD₂₀) of 10.24 µmol or less; and a mean daily symptom score of one or more during the run in period. Subjects taking treatment other than sodium cromoglycate (one subject) were excluded.

Written consent was obtained from all subjects and Nottingham City Hospital ethics committee approved the study.

Measurements

FEV₁ and forced vital capacity (FVC) were measured with a dry bellows spirometer (Vitalograph, Buckingham, UK) as the highest of two successive readings within 100 ml. Methacholine PD₂₀ was measured by a breath activated dosimeter (MEFAR, Brescia, Italy). Nebulisers had an output of 10 (0.5) µl at 1 second and calibration was checked every 6 months. Subjects inhaled three puffs of saline followed by doubling doses of methacholine (dose range 0.02–42 µmol) until FEV₁ had fallen by 20% from the post-saline value. FEV₁ was measured 2 minutes after each dose and PD₂₀ by linear interpolation on a log-dose response plot.

Subjects kept diary cards to record breathing exercises, medication use, and asthma symptom severity during the day and night (both 0–5), plus activity limitation due to asthma (0–3; maximum combined score 13). Quality of life was assessed using the SF-36 and Asthma Quality of Life questionnaires.
Protocol

The study had a parallel group design with participants randomised to be taught the Eucapnic Buteyko technique or use of the PCLE or PCLE placebo device. Subjects underwent training (see below) and were asked to perform the exercises for at least 15 minutes twice a day throughout the study. A card sent 2 weeks later gave further encouragement. Subjects were followed for 6 months with an optional extension during which inhaled steroid reduction was attempted.

Bronchodilator reversibility and methacholine PD$_{20}$ were measured on separate screening visits. Subjects fulfilling the entry criteria entered a 2 week run in period. Eligible subjects were then allocated to one of the three treatment groups using the next available number from computer generated numbers, randomised in blocks of six, and using sealed envelopes prepared independently. To ensure sufficient numbers for the Buteyko sessions, randomisation was skewed towards the Buteyko group except for the last 12 patients who were randomised between the two PCLE groups. Subjects were only given details of their treatment. They attended the clinic after randomisation between the two PCLE groups. Subjects were only asked to breathe in and out from residual volume to total lung capacity at a rate at which they felt no resistance to breathing and could feel no cheek movement. If, after a week, they could do the exercises without feeling breathless, they were encouraged to decrease the aperture size gradually to reduce respiratory rate. They were told to use their β$_2$ agonist only for relief of symptoms.

Control group

Training was identical to that for the PCLE group. The placebo device had an identical appearance to the PCLE but the apertures had no valve and a leak ensured no resistance to breathing.

Outcome measures

The primary efficacy variables were symptom scores and methacholine PD$_{20}$. Secondary outcomes included FEV$_1$, bronchodilator use, asthma exacerbation rates, quality of life assessments, and reduction in inhaled corticosteroid dose.

With 30 subjects in each group there was 90% power to detect a difference between treatments in change from baseline methacholine PD$_{20}$ of 1.5 doubling doses using an α of 0.05 according to previous data. Analysis of data

All available data for the 89 patients who underwent training were analysed. When data were unavailable they were treated as missing. Codes were revealed after all data had been reviewed and entered. PD$_{20}$ values were log transformed for analysis and expressed as change from the end of the run in period, or worsening asthma needing urgent medical care or rescue medication on two of three successive nights.

Steroid reduction phase

Steroid reduction was attempted 6 months after randomisation for subjects with stable asthma who agreed to take part. The dose was reduced by 25% every 3 weeks at a clinic visit until either the inhaled steroid had been discontinued, an asthma exacerbation occurred, or the doctor or subject felt that asthma control had deteriorated to an extent that merited reversal of steroid reduction.

Training

Training was given in small groups: numbers ranged from 3–8 in the Buteyko training sessions, 2–5 in the PCLE group, and 1–5 in the control group.

Buteyko group

The Eucapnic Buteyko technique, a western modification of the Russian Buteyko technique, was taught by a certified practitioner in five 2 hour sessions over a weekend or successive evenings. Subjects were taught exercises to reduce the frequency and depth of breathing and, as part of the technique, were asked to record pulse and breath holding time twice daily in a diary. They were instructed to use the breathing technique twice daily and to relieve asthma symptoms, and only to use their bronchodilator if that failed. Subjects were also asked to tape their mouth at night with hypoallergenic tape (Micropore) to prevent mouth breathing and were advised to avoid factors such as stress, exercise accompanied by deep breathing, oversleeping, and certain foods (for example, highly processed food and additives). Two weeks after the training the subjects were telephoned by the Buteyko practitioner to give encouragement and answer ques-

Primary outcome measures

There was little change in PD$_{20}$ from baseline during the study and no significant difference between the groups at 3 and 6 months (table 2).
The use of Secondary outcome measures the Buteyko group; the difference between the three groups group, –1 (–2 to 0.75) in the PCLE group, and –3 (–4 to 0) in symptom scores at 6 months was 0 (–1 to 1) in the placebo group, 0 (–2 to 0) puffs/day in the PCLE group, and –2 (–4 to 0) in the Buteyko group (fig 2). The median (IQR) change at 6 months 0 (–2 to 0) puffs/day in the placebo groups but were reduced in the Buteyko group (fig 2).

Symptoms remained relatively stable in the PCLE and placebo groups but were reduced in the Buteyko group (fig 2). The median (interquartile range, IQR) change in daily symptom scores at 6 months was 0 (–1 to 1) in the placebo group, –1 (–2 to 0.75) in the PCLE group, and –3 (–4 to 0) in the Buteyko group; the difference between the three groups significant, p=0.005). There was no difference in the Asthma Quality of Life questionnaire domains had changed significantly at 6 months (see table 4 online at www.thoraxjnl.com/supplemental for details)

Steroid reduction phase
Of 69 subjects who completed the study, nine were unwilling to attempt steroid reduction leaving 60 in the analysis with similar numbers in each group (fig 1). The extent to which subjects could reduce their inhaled steroid did not differ significantly between groups (p=0.7; table 3, fig 3)

Feedback from subjects
At the end of the study more subjects in the Buteyko group thought that they had definitely or probably received active treatment (15 + 8 of 26 respondents) than subjects in the PCLE group (4 + 9 of 25) or the placebo PCLE group (4 + 10 of 25) (p<0.001).

There were 72 replies (81% response rate) to the postal questionnaire. Most subjects said they had been compliant
with the breathing exercises during the study (see table 5 online at www.thoraxjnl.com/supplemental). Of 23 responders in the Buteyko group, 22 said they had practised the exercises twice a day while 14 in the PCLE group and 17 in the placebo PCLE group said they had practised for at least 10 minutes a day. Four subjects in the Buteyko group were unable to tape their mouth at night but 14 said they did it for at least five nights a week and eight did it every night. After completing the study 16 subjects in the Buteyko group had continued the exercises, at least on an occasional basis, compared with 12 and 9 in the PCLE and placebo PCLE groups.

DISCUSSION

In this randomised controlled trial subjects taught the Eucapnic Buteyko technique had reduced asthma symptoms and bronchodilator use compared with the other two groups but there was no difference in bronchial responsiveness or FEV1. No difference was seen between the PCLE and PCLE placebo device for any outcome measure.

A television programme in 1998 in the UK generated considerable media and patient interest in the Buteyko technique. The course used in this study, the Eucapnic Buteyko technique, was available to the general public. It includes breathing exercises, taping the mouth at night, strongly discouraging the use of $\beta_2$ agonists except in emergencies, advice on lifestyle, and strong practitioner encouragement. Yoga breathing exercises (pranayama) involves mental concentration to cause a reduction in breathing frequency, a 1:2 ratio of inspiration to expiration, and a pause at the end of inspiration and expiration. The expiratory resistance in the PCLE imposes a reduction in breathing frequency and expiratory flow.

Over 90% of 100 000 patients who completed the Buteyko course in Russia are said to need no further asthma medication and a similar success rate has been claimed for 8000 patients in Australia. The results of the two controlled studies from Australia in 39 and 36 subjects are more modest. In one, which focused on patients taking high doses of short acting $\beta_2$ agonists (median >800 µg salbutamol daily), Buteyko training resulted in a large reduction in $\beta_2$ agonist use which correlated with a reduction in minute ventilation compared with the control group. There was a

### Table 1 Baseline characteristics of study patients

<table>
<thead>
<tr>
<th></th>
<th>Control (n=29)</th>
<th>Buteyko (n=30)</th>
<th>PCLE (n=30)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>47 (11)</td>
<td>40 (11)</td>
<td>45 (13)</td>
</tr>
<tr>
<td>M/F</td>
<td>18/11</td>
<td>15/15</td>
<td>16/14</td>
</tr>
<tr>
<td>Inhaled corticosteroid dose (µg)</td>
<td>603 (330)</td>
<td>757 (370)</td>
<td>608 (529)</td>
</tr>
<tr>
<td>Never/ex-smokers</td>
<td>16/13</td>
<td>20/10</td>
<td>15/15</td>
</tr>
<tr>
<td>Duration of asthma (years)</td>
<td>23 (15.3)</td>
<td>24 (14.7)</td>
<td>23 (14.1)</td>
</tr>
<tr>
<td>FEV1 (l)</td>
<td>2.71 (0.89)</td>
<td>2.58 (0.76)</td>
<td>2.64 (0.94)</td>
</tr>
<tr>
<td>FEV1 (% predicted)</td>
<td>82 (21.1)</td>
<td>77 (16.4)</td>
<td>80 (17.6)</td>
</tr>
<tr>
<td>Reversibility (%)</td>
<td>17 (8.3)</td>
<td>19 (13.3)</td>
<td>16 (6.2)</td>
</tr>
<tr>
<td>Median (IQR) $\beta_2$ agonist use (puffs/day)</td>
<td>2 (0–3.8)</td>
<td>2 (0–4)</td>
<td>2 (0–4)</td>
</tr>
<tr>
<td>Geometric mean (IQR) PD$_{20}$ methacholine (µmol)</td>
<td>0.66 (0.2–2)</td>
<td>0.19 (0.07–0.6)</td>
<td>0.65 (0.2–2.8)</td>
</tr>
<tr>
<td>Median (IQR) symptom score</td>
<td>3.5 (2–5.8)</td>
<td>4 (2.8–5.3)</td>
<td>4 (3–6)</td>
</tr>
<tr>
<td>Overall asthma quality of life score*</td>
<td>5 (0.8)</td>
<td>5.1 (1.0)</td>
<td>4.9 (0.8)</td>
</tr>
</tbody>
</table>

Values are mean (SD) unless stated otherwise.

PCLE=Pink City Lung Exerciser; FEV1=forced expiratory volume in 1 second; PD$_{20}$=dose of methacholine provoking a fall in FEV1 of 20% or more.

*More detailed quality of life baseline measurements are available online in table 1b at www.thoraxjnl.com/supplemental.

### Table 2 Change from baseline PD$_{20}$ methacholine at 3 and 6 months

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>Buteyko</th>
<th>PCLE</th>
<th>Estimated difference* (95% CI) between:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Buteyko v control</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>PCLE v control</td>
</tr>
<tr>
<td>13 weeks</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>n</td>
<td>25</td>
<td>26</td>
<td>24</td>
<td>-0.3 [-1.2 to 0.5]</td>
</tr>
<tr>
<td>Mean</td>
<td>0.25</td>
<td>0.28</td>
<td>0.12</td>
<td>-0.03 [-0.8 to 0.8]</td>
</tr>
<tr>
<td>SE</td>
<td>0.28</td>
<td>0.33</td>
<td>0.27</td>
<td></td>
</tr>
<tr>
<td>26 weeks</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>n</td>
<td>22</td>
<td>22</td>
<td>23</td>
<td>0.1 [-1.0 to 1.2]</td>
</tr>
<tr>
<td>Mean</td>
<td>-0.04</td>
<td>0.66</td>
<td>0.44</td>
<td>0.6 [-0.4 to 1.6]</td>
</tr>
<tr>
<td>SE</td>
<td>0.39</td>
<td>0.26</td>
<td>0.44</td>
<td></td>
</tr>
</tbody>
</table>

PCLE=Pink City Lung Exerciser.

PD$_{20}$ is measured in doubling doses. Two subjects who completed the study did not have a PD$_{20}$ measurement at 6 months.

*Adjusted for baseline values.

**Figure 2** Median change in symptom scores during the 6 month study.
In a previous comparison of the PCLE and placebo device in subjects with mild asthma, the active PCLE caused a small reduction in bronchial responsiveness. We were unable to confirm this in the current study, perhaps because of differences in the populations studied or study duration. The PCLE involves only one aspect of yoga, and a 4 month trial of Sahaja yoga in asthma showed benefit over a control intervention.

The need for controlled studies of complementary medicine is widely recognised with recent endorsement from a presidential commission in the US and a House of Lords Select Committee in the UK. Such studies are difficult to carry out, however, and our study raises several issues. The choice of a suitable control is one difficulty; subjects in the Buteyko group were more likely to believe they were receiving active treatment resulting, perhaps, in greater psychological benefit. On the other hand, use of the placebo PCLE as a control involved subjects in some change from usual practice since they were asked to focus on breathing for 30 minutes a day. Some subjects may have benefited from this since nine continued to use the device after the study ended, despite being told it was the placebo device. Any benefit from the placebo device would reduce the ability of the study to detect an effect from the other interventions. Maintaining blindness is another potential problem. Asking subjects not to mention the technique to the assessor worked reasonably well, although one mentioned Buteyko and an occasional subject used a device, but which device was not clear. A formal study may also interfere with usual practice. A previous study was criticised because the Buteyko group received more follow up visits than the control group so we only included one follow up telephone discussion with the Buteyko practitioner. Most subjects were happy with this but nine would have liked more contact.

A further problem is that advice from complementary medicine practitioners may differ from conventional advice and a few subjects found this difficult, particularly knowing whether to use a β2 agonist or the Buteyko technique to control worsening asthma. Finally, the success or failure of a treatment such as Buteyko relies heavily on the patient/practitioner relationship. The training sessions are long and patients need to be highly motivated to commit themselves fully to the training and need to practise daily. The success rate in a formal trial might therefore be less than that seen in everyday practice, since subjects did not specifically choose the Buteyko course and, because they were not paying, they may have felt less committed to seeing it through. Furthermore, subjects who may be considered unsuitable by Buteyko practitioners were not necessarily excluded by our entry criteria.

Despite these problems, which are inherent in all studies of complementary medicine, and the differences in study design between our study and the previous controlled studies, our findings are broadly similar. They suggest that the Buteyko technique produces some benefit by reducing symptoms and use of bronchodilators and it may improve some aspects of compliance.
quality of life. None of the studies found any improvement in airway calibre, however, and we found no effect on bronchial responsiveness or asthma exacerbations. The Buteyko technique may be worth trying in patients who are sympathetic to the ethos and are willing to commit the time required.

ACKNOWLEDGEMENTS
The study was supported by The National Asthma Campaign. The authors thank Susan Mitchell and “Lifesource” for running the Pink City Lung Exercisers and placebo devices. The authors are grateful to Tim Harrison for reviewing the manuscript and for providing medical cover and advice, along with Kate Phillips, and to Marie Cooper for help with the data entry.

Baseline quality of life characteristics (table 1b), changes in quality of life scores (table 4), and details of the postal questionnaire sent to subjects at least 6 weeks after the end of the study (table 5) are available online at the Thorax website (www.thoraxjnl.com/supplemental).

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9 Buteyko Breathing Centre. http://www.buteyko.co.uk/trials.html

LUNG ALERT

Anti-CD44 antibodies decrease airway inflammation and hyperresponsiveness in a murine model of allergic disease

This study investigated the effects of anti-CD44 murine antibodies on allergic airway inflammation induced by transnasal instillation of purified Ascaris suum (Asc) antigen. Two antibodies were used—one that directly blocks hyaluronic acid binding to cells expressing CD44, and one that causes CD44 receptor to be shed from tissue surfaces.

The study showed that the total number of airway eosinophils and lymphocytes increased after challenge with Asc and both types of anti-CD44 antibody significantly suppressed cell levels (p<0.05). Asc induced increases in interleukin (IL)-4 and IL-5 levels in bronchoalveolar lavage fluid were reduced after use of anti-CD44 antibodies (p<0.05). Levels of eotaxin and TARC were also reduced (p<0.05). Airway hyperresponsiveness to methacholine was analysed; anti-CD44 antibodies significantly reduced the response in Asc treated mice compared with rat IgG (p<0.05). Hyperresponsiveness was also significantly decreased in mice (Dermatophagoides) allergen treated mice given anti-CD44 antibody (p<0.05).

These results show that CD44 may play an important role in allergic airway inflammation through its actions on leucocyte binding and stimulation of cytokine production. Further evaluation of the interactions between IL-4, IL-5, and CD44 may determine which factor is most influential in airway inflammation and clarify the role of the eosinophil in asthma.

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