Complementary Therapies in Medicine (2005) 13, 41—46

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Complementary Therapies in Medicine

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The Buteyko breathing technique for asthma: A review

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Summary Breathing exercises and breathing retraining are often used in the management of asthma. One specific form of breathing therapy, known as the Buteyko breathing technique (BBT) has received considerable attention, but there is a paucity of rigorous research evidence to support its recommendation for asthma patients. There are only four published clinical trials and two conference abstracts evaluating BBT. Although all have reported improvements in one or more outcome measures, results have not been consistent.

This article provides the background to the BBT, reviews the available evidence for its use and examines the physiological hypothesis claimed to underpin it. In common with other therapies, BBT is not a standardised treatment modality. The BBT 'package' is complex, as it also includes advice and education about medication use, nutrition and exercise, and general relaxation. This makes it difficult, and possibly inappropriate, to attempt to tease out a single mechanism. Buteyko's theory relating to carbon dioxide levels and airway calibre is an attractive one, and has some basis in evidence from experimental studies. However, it is not known whether altering breathing patterns can raise carbon dioxide levels significantly, and there is currently insufficient evidence to confirm that this is the mechanism behind any effect that BBT may exert. Further research is necessary to establish unequivocally whether BBT is effective, and if so, how it may work.

Introduction

The burden of asthma is increasing causing severe socioeconomic strain.[1] Although the greatest healthcare costs are as a result of hospitalization, the second greatest cost is for medication (£850 million p.a. in the UK).[2] Breathing exercises have been incorporated into various therapies for asthma and hyperventilation. The nature of the breathing exercise varies with the nature of the therapy, the therapists and the cultural background.[3] However, two systematic reviews of breathing exercises for

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0965-2299/$ — see front matter © 2005 Elsevier Ltd. All rights reserved.
doi:10.1016/j.ctim.2005.01.003

asthma have identified little published suitable for inclusion.[4,5] There is, therefore, insufficient evidence to support the recommendation of breathing exercises in asthma.[6] Opinions differ as to the proportion of UK asthma sufferers who currently use such therapy. The National Asthma Campaign found that 30% of respondents were using breathing exercises.[7] However, Partridge et al.'s[8] study evaluating a stratified cross section of the asthma population found only 6% using such therapy. The House of Lords Select Committee's enquiry into complementary and alternative medicine (CAM)[9] revealed that around 5 million people had consulted a CAM practitioner in 1999, despite a lack of robust research evidence.

Physiotherapists and others have routinely used breathing exercises to treat patients with hyperventilation symptoms. The aim is to develop a more efficient pattern of respiration by 'normalising' the breathing pattern, thereby reducing breathlessness. The relationship between asthma and hyperventilation is complex and it can be difficult to distinguish true asthma from asthma-like symptoms induced by overbreathing.[10] Nevertheless, whatever the underlying mechanism for hyperventilation, there is evidence to suggest that it can lead to significant increases in airway resistance.[11] Recently a technique with similar aims to physiotherapy, the Buteyko breathing technique (BBT), has received considerable attention. The purpose of this article is to provide some background to BBT, review the available evidence for its effectiveness, and examine the physiological hypothesis behind it.

Background

The late Professor Konstantin Buteyko was a Russian physiologist (1923—2003) who gave his name to a novel treatment approach that is currently being applied to patients with asthma in a number of countries. The approach varies in some details in different countries and with different practitioners, but essentially consists of a package of breathing therapy, relaxation techniques and exercises combined with advice and education about medication use, nutrition and general health. Professor Buteyko theorised that 'hidden' hyperventilation is the basic cause of asthma. This theory is given some support by Thomas et al.[12] who surveyed 210 asthma patients using the Nijmegen questionnaire and found that a third of females and a fifth of males surveyed had scores suggestive of dysfunctional breathing. This questionnaire is a validated screening tool that has been shown to have 95% effectiveness in distinguishing hyperventilators from "normals".[13] It consists of 16 items of sensations associated with hyperventilation. Buteyko suggested that hyperventilation leads to a reduction in blood and alveolar CO_2 levels to which the airways respond by constricting to prevent further loss of CO_2.[14] Conventional medication, in the form of bronchodilators, is said to exacerbate the loss of CO_2 and compound the symptoms when the bronchodilator wears off. By teaching people to underbreathe it is hypothesized that they will be able to raise their CO_2 levels and thus encourage bronchodilatation without medication.

Buteyko's techniques were developed in the 1950s but until recently they received little attention outside Russia. BBT is currently being taught in Europe, Australia, New Zealand, and the USA. There is some scientific support for the underlying physiological theory in the recent work by Osborne et al.[10] who found that stable mild asthmatic patients had significantly lower resting CO_2 levels than healthy matched controls. There is also some evidence suggesting that CO_2 acts directly on the airway smooth muscle to cause bronchodilatation[15] while low CO_2 causes bronchoconstriction.[16,17] However, this CO_2 hypothesis does not fit with other respiratory disorders in which a low CO_2 does not seem to be associated with bronchoconstriction.

As with many complementary medical interventions, it may be that the specific effect of the therapy is far less powerful than the non-specific effect of the therapeutic relationship and patient empowerment.[18] This certainly requires further investigation.

Buteyko technique

The major component of the Buteyko 'package' is breathing therapy. The breathing component aims to reduce hyperventilation through periods of controlled reduction in breathing, known as 'slow breathing' and 'reduced breathing', combined with periods of breath holding, known as 'control pauses' and 'extended pauses'. These techniques are very similar to those routinely used by respiratory physiotherapists for patients with hyperventilation symptoms. In Buteyko, they are sometimes accompanied by physical activities to increase the build-up of CO_2. The emphasis is on self-monitoring using the pulse rate and the 'pauses' as objective measures of outcome. Classical Buteyko theory would suggest that there is a direct relationship between the length of the 'control pause' and

CO_2 levels. No evidence has been published outside Russia that would support this hypothesis. There are two main problems with the hypothesis: one is that the nature of the 'control pause' is that it is dependent on subjective sensations of 'air hunger' or 'lack of air', which may not be consistent over time within or between individuals. The second problem is that the hypothesis assumes that the drive to breathe is only related to CO_2 levels. Since it can be demonstrated experimentally that providing supplemental oxygen can increase breath holding time,[19] it is likely that hypoxia is also relevant. However, Nishino et al.[20] have found an inverse relationship between the period of 'no respiratory sensation' during breath holding and the slope of the CO_2 response curve.

BBT also includes advice and training on the benefits of nasal breathing over oral breathing. The nose not only warms, filters and humidifies the inspired air, but also produces nitric oxide—a potent bronchodilator. One proposed model for asthma[21] is that exposure to an allergen causes some bronchospasm which gives rise to the sensation of dyspnoea and chest 'tightness'. The natural response is for the patient to try to breathe more deeply through the mouth, thereby inhaling more allergen and both cooling and drying the airways—thus provoking further bronchospasm and a greater drive to breathe. Resisting this urge to overbreathe is the core of the Buteyko training. There is evidence to suggest that people with asthma use oral breathing more than healthy controls[22] and Buteyko patients are encouraged to breathe through the nose during the day and to try 'taping' the mouth at night using Micropore™, to encourage nasal breathing. Various 'nose clearing' exercises are also taught. Although mouth taping has given rise to some controversy, there is no evidence that this can be in any way harmful.

Another common component of BBT is advice on medication use. This usually involves encouraging patients to minimise their use of β_2 agonists and is in line with Buteyko philosophy that 'reliever' inhalers exacerbate the loss of CO_2. Unfortunately such advice may invalidate medication usage as an outcome measure for clinical research.

Standardisation of BBT training

In clinical practice, the delivery of BBT is not a standard form of treatment. It will differ between one practitioner and another, and will also be individualised for each patient. Such variability is common to many forms of therapeutic practice, including 'mainstream' therapies like physiotherapy. In clinical research it is therefore essential to provide an adequate description of the methodology employed, with clear explanations of the Buteyko training provided. The trials published so far have involved interventions delivered by representatives from different Buteyko organisations, with insufficient detail to be certain of the exact content of the intervention.

The evidence so far

There are two questions to be posed about BBT: (1) Does it work? (2) If it does work, how does it work? Despite many advocates, claims made that BBT provides a 'drug-free' solution for asthma sufferers have yet to be substantiated. Because guidelines for asthma management emphasize the importance of regular controller therapy with anti-inflammatory asthma drugs, any alternatives require rigorous assessment. However, a review of the literature via PubMed (1966—2004), Embase (1966—2004), Cinahl (1982—2004) and Web of Science™ (1992—2004) revealed only four randomised controlled trials (RCT) involving Buteyko published in full and two in abstract form (see Table 1). A rigorous systematic review was therefore not felt to be appropriate and the six trials are described below.

The first RCT involved a study of 39 asthma patients randomised to receive BBT or control (asthma education and relaxation) over 7 days.[23] At 3 months post-intervention minute ventilation and β_2-agonist use were significantly less in the intervention group ($p = 0.002$). However, methodological flaws (e.g. uncontrolled telephone contact between the Buteyko practitioner and the intervention group, lack of validated outcome measures) question the significance of these findings. A second study by Opat et al.[24] involved 36 subjects with mild-moderate asthma, randomised to receive Buteyko training by video versus a relaxation video. The intervention group again showed significant reductions in medication use compared with the control group, as well as improvements in quality of life. As already noted, medication usage is part of the advice/education package offered by Buteyko practitioners, and so may not be the most appropriate outcome measure. Nevertheless, reduction in medication use was also found by Cooper et al.,[18] McHugh et al.,[25] and McGowan.[26] Cooper et al. reported an RCT in which 90 patients with asthma were randomised to receive BBT, a device which mimics pranayama (a yoga breathing technique), or a dummy pranayama device. Bronchial responsiveness and symptoms were compared over 6 months in a parallel group study. The results

Table 1 Randomised controlled trials involving Buteyko breathing.

First author (date)	Study participants	Study design	Outcome measures	Significant Results
Bowler (1998)[23]	39 adults in 2 groups	1. BBT vs. 2. Education + relaxation + breathing exercises	Medication use; PEF; FEV_1; MV; $ETCO_2$; QoL	↓Medication use ↓MV
Opat (2000)[24]	36 adults in 2 groups	1. BBT video vs. 2. Placebo video	Medication use; symptom scores; PEF; QoL	↓Medication use ↑QoL
Cooper (2003)[18]	90 adults in 3 groups	1. BBT vs. 2. Yoga device vs. 3. Placebo device	Symptom scores; BHR; medication use; FEV_1; QoL; exacerbations	↓Symptoms ↓Medication use
McHugh (2003)[25]	38 adults in 2 groups	1. BBT vs. 2. Education + relaxation	Symptom scores; medication use; FEV_1	↓Medication use
McGowan (2003)[26]	600 adults in 3 groups	1. BBT vs. 2. Asthma education vs. 3. Medication control	QoL; activity; symptom scores; medication use	↓Symptoms ↓Medication use
Abramson (2004)[28]	95 adults in 4 groups	1. BBT + placebo video vs. 2. Asthma education + Buteyko video vs. 3. Asthma education + placebo video vs. 4. BBT + Buteyko video	Medication use; symptom scores; QoL; FEV_1; $ETCO_2$; response to CO_2	↑$ETCO_2$ (4 vs. 3)

BBT: Buteyko breathing technique; BHR: bronchial hyperresponsiveness; $ETCO_2$: end tidal carbon dioxide; FEV_1: forced expiratory volume in 1 s; MV: minute ventilation; PEF: peak expiratory flow; QoL: quality of life.

were that the Buteyko group showed improvements in symptoms and reduced bronchodilator usage when compared to both of the other groups, but no change in either bronchial responsiveness or lung function. In the McHugh et al. RCT, 38 people with asthma were randomised to receive BBT or a control intervention consisting of asthma education and poorly described relaxation techniques. Relaxation may not be the ideal control, as a systematic review by Huntley et al.[27] found some evidence that relaxation therapy may improve lung function in asthma. However, no changes in lung function (percentage predicted FEV_1) were found in either group in the McHugh trial. In a controlled trial currently only published in abstract form, Abramson et al.[28] have also reported no changes in lung function in the 95 adults studied. However, they did find a significant increase in end tidal CO_2 in one group and some non-significant reduction in response to CO_2 in another. They employed a factorial design involving four groups, one receiving 'full' Buteyko (Buteyko practitioner plus Buteyko video), two receiving 'partial' Buteyko (Buteyko practitioner plus placebo video, or Buteyko video plus placebo educator) and one receiving no Buteyko (placebo video plus placebo educator). Their findings are interesting but the complexity of their design makes interpretation difficult. A much larger trial involving 600 adults has been published in abstract form by McGowan.[26] Reductions in both medication use and symptoms are reported, with these changes persisting over the 12 months. However, the abstract provides insufficient detail to judge the rigour of the methodology employed. At present, therefore, there is insufficient evidence to support a specific effect from BBT.

Buteyko mechanism

There is even less evidence about its mechanism of action. Conventional Buteyko theory states that hyperventilation causes the excessive removal of CO_2, resulting in a change in homeostasis which is partially neutralised by various compensating mechanisms. The hyperventilation theory is based upon respiratory physiology, acid—base balance and biochemistry.[29] Inappropriate hyperventilation leads to reduced levels of CO_2 and hence a raised

blood pH (respiratory alkalosis). This alkalosis affects the oxygen—haemoglobin dissociation curve, shifting it to the left and thus increasing the affinity of haemoglobin for oxygen, thereby causing less oxygen to be released into the tissues.[30] Thus, although oxygen saturation measures may be normal, tissue hypoxia is still possible. Buteyko believed that the altered pH is responsible for extracellular electrolyte imbalance leading to disruption of the synthesis of proteins, peptides, nucleic acids, lipids and carbohydrates, and to a decrease in the formation of ATP. Buteyko stated that the classic symptoms associated with the diagnosis of asthma (i.e. cough, shortness of breath and wheeze) can all be attributed to the underlying dysfunctional breathing pattern involving increased minute ventilation and mouth breathing. The resultant loss of CO_2 induces bronchospasm as the body's attempt to prevent further loss of this naturally occurring bronchodilator. Buteyko suggested that the administration of a bronchodilator merely compounds the problem by overriding the body's defence mechanism, causing further loss of CO_2 and worse symptoms when the bronchodilator wears off.

To date there is insufficient evidence to know if any of the Buteyko techniques have an effect on CO_2 levels. However, the Bowler et al. trial[23] showed no difference in end tidal CO_2 levels between the Buteyko group and the control group, despite significant reductions in minute ventilation. Unfortunately the data concerning individual changes in CO_2 from baseline to outcome within each group are not published. It has been suggested by Al-Delaimy et al.[31] that CO_2 is unlikely to play a significant role in any effect that Buteyko training may have. They performed an experiment in which they tried to prevent exercise-induced asthma by giving subjects additional CO_2. Only 10 subjects completed the double-blind crossover study, results indicating that the mean drop in FEV_1 was similar in those breathing air and those breathing added CO_2. Interestingly, when those breathing CO_2 returned to breathing air, they experienced a further drop in FEV_1, suggesting that the higher CO_2 may have been exerting some bronchoprotective effect.

While the CO_2 hypothesis remains unconfirmed, it is possible that there are other specific mechanisms (such as nitric oxide), but none have been tested experimentally. Alternatively, non-specific mechanisms may be involved. It is acknowledged that the non-specific effect of any therapy can be very powerful[32] and the Buteyko techniques require considerable clinician contact time.

Outcome measures

Table 1 illustrates the variety of outcome measures used in Buteyko trials. Unfortunately, one of the commonest is 'medication use', which is clearly of great importance to individual patients, particularly if achieved with concomitant stability, or reduction, of asthma symptoms. However, it is inappropriate for research in which the intervention encourages reduction in β_2 agonist use. Buteyko practitioners believe that objective measures of lung function may also not be entirely appropriate for Buteyko trials, as recording FEV_1 requires a forced expiratory manoeuvre that may itself provoke bronchoconstriction. The standard measure for assessing bronchial reactivity (a methacholine or histamine challenge) requires multiple measures of FEV_1. However, it could be argued that any improvements in lung function that are so readily reversible may be of doubtful clinical value.

From a patient's perspective, alternative outcome measures such as quality of life, hospital admissions, days off work, etc. may be of greater importance; and despite the paucity of controlled trials, many Buteyko practitioners and asthma patients who have received the training believe the technique to be beneficial. Although the aetiology of asthma is very complex and still poorly understood, the common feature of the disease is the inflammatory process that affects the airways. Any therapy that claims to be able to improve the condition must therefore have an effect on this inflammatory process, either through its prevention or control. As yet there is no convincing evidence that Buteyko consistently exerts this effect.

Conclusion

This article describes the background to BBT and the physiology behind it, and reviews the available evidence for its effectiveness. There is currently no cure for asthma, so treatments are aimed at controlling or relieving symptoms. BBT is a complementary therapy that has been found by some to achieve this aim, but without any evidence of change in objective lung function measures, or bronchial responsiveness. Classical Buteyko theory proposes that changes in carbon dioxide are the mechanism behind any effect, so it is perhaps surprising that only one study, of the four controlled trials published in full, included measures of carbon dioxide levels. Further work is needed to confirm or

refute the idea that altering breathing patterns can really have a significant effect on this parameter. Despite many enthusiastic proponents of the value of Buteyko, further research is also necessary to establish equivocally whether BBT is effective, and if so, how it may work.

Acknowledgements

Anne Bruton is funded by a Postdoctoral Research Fellowship from the UK Department of Health. George Lewith is funded by a grant from the Maurice Laing Foundation.

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