Forced expiration exercises in asthma and their effect on FEV[1]

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Many authorities say that forced or prolonged expiration in the treatment of asthma is wrong. Prolonged expiration can only be obtained by slowing the respiratory rate and disturbing the respiratory cycle. This leads to increased oxygen consumption and makes it difficult to increase respiratory rate in response to exercise, maximum breathing capacity depending on the rate as well as the depth of respiration. In addition, bronchial diameter decreases during expiration. Forcible or prolonged expiration accentuates this. For all of these reasons, prolonged or forced expirations have been discarded by many physiotherapists in the treatment of asthma.

In the tuition of normal breathing or breathing control we would agree entirely with this. Diaphragmatic movement during expiration is entirely a passive recoil. Prolonged expiration cannot play any part in re-education of the diaphragm. It has been stated by Gandevia (1964) that mucus is not the important factor in simple asthma. We feel that it is certainly quite as important as bronchospasm, mucosal thickening and other factors such as poor breathing pattern and tense posture.

In making this statement, Gandevia appears to make a distinction between severe asthma states and simple asthma.

It is well known that patients who die in status asthmaticus do so with their bronchial trees completely blocked with inspissated mucus. We believe that the difference between simple and severe asthma is one of degree rather than kind and the removal of mucus makes an important contribution to the relief of breathlessness which is at least partly due to sticky plugs and casts in the smaller air ways. We further believe that no amount of relaxation will remove these casts. Forced expiration by producing an accentuation of the normal expiratory movements of the bronchial tree, i.e., narrowing and shortening, squeezes mucus from the small peripheral to the larger central bronchi. From here it can be coughed up. We believe that mucus is moved in the more peripheral bronchi, not by a blast of expired air, but by the squeezing action of the narrowing and shortening of the bronchial tree during forced expiration the peripheral branches shortening towards the central bronchi. We have demonstrated this pattern of movement by cine-radiography. Our use of forced expiration is solely for the upward movement of mucus.

Another argument against the use of forced expiration is that it actually irritates the bronchial mucosa and produces more mucus. If this were so, patients who practise this technique would never dry out. We find that even with an increasing programme of forced expiration activity, many patients dry out completely. Furthermore, some patients who have reached this state and give up their forced expiration exercises because they feel so well, gradually fill up again.

Complete rehabilitation depends on:

(1) Management of the attack by relaxation and breathing control, i.e., inspiratory diaphragmatic mobilization and modified forced expiration.

(2) Between attacks – a graduated scheme of coughing exercises to keep the air ways clear. Forced expiration is the simplest and most effective means of producing adequate coughing. Being aware that it increases spasm leads the physiotherapist to modify its use. A successful mixing of forced expiration and breathing control will wheedle sputum from patients who have tried all other methods unsuccessfully.

(3) Again, between attacks, postural and mobilizing exercises.

RESPIRATORY FUNCTION TESTS

As a result of the controversy that has arisen about our use of forced expiration in asthma treatments, we have recently carried out a series of respiratory function tests before and after use of this method.

Forced Expiratory Volume in one second or FEV[1], the test we have used, is universally accepted as a satisfactory test of air ways obstruction.

Exercise, per se, has been shown by Jones et al (1962) to produce a decrease of FEV1 in asthmatics even when symptom free.

Recently, over a two-month period, we tested all our patients in the age group between two and twenty years. Most of the children were between five and fifteen years of age. This is a group comparable to that tested by Jones. Some patients are at the beginning of their treatment – a first or second day. Some are weeks, months or years after commencing treatment by this form of breathing exercises.

Patients demonstrate various levels of distress. The estimate of treatment was made and given by three different physiotherapists; vitallograph tests were conducted in a room off the treatment and class rooms. Room temperatures were the same in all rooms. No bronchodilators or other drugs were used.

Respiratory function tests have tallied with our clinical findings. In some cases, improvement has exceeded our expectations.

Exercises are graded according to the information given in the books, *Better Breathing* and *Asthma and Your Child* (Thompson, 1967, 1968). In general, a first treatment would consist of two exercises each using tipping or twisting movements of the chest combined with arm swinging. The movements are

Thompson B and Thompson HT (1968): Forces expiration exercises in asthma and their effect on FEV1. *New Zealand Journal of Physiotherapy* November; 19-21. A paper presented at the New Zealand Society of Physiotherapists' Conference, March 23, 1968.

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done approximately six times each and forced expiration is performed as vigorously as possible in time with the exercise. At its conclusion, a vigorous double cough is encouraged. It is not always expected that patients will spit up mucus at this stage. All patients are given postural drainage. On the first occasion it would average six forced expirations and a good cough twice each side. Nose blowing is encouraged occasionally throughout the treatment and at its conclusion. Diaphragmatic breathing and relaxation is always encouraged between exercise changes and at conclusion of the treatment until the patient is comfortable. If treatment is correctly judged, this should take no longer than a minute.

Over a variable period according to the patient's mastery of breathing control, the exercise programme is extended. It gradually includes more of the vigorous forced expiration exercises which are always followed by postural drainage as previously described.

RESULTS

During the two-month period of testing at the beginning of this year 111 patients were tested. Of these, 91 patients were improved, six remained the same and 14 were worse. Subsequently, all of the 14 patients who became worse have been retested and now show improvement. Two of the patients whose FEV^1s were unchanged now show improvement and four remain unchanged. Some of these have not been available as yet for re-testing.

The percentage of improvement in all cases ranges from 0% to 150% with an average of 33%.

CONCLUSIONS

From these results we have reached the following conclusions:

The measurement of FEV^1 before and after our type of breathing exercises makes it abundantly clear that in the vast majority of asthmatics in this age group, bronchial obstruction is not increased, but in fact the airways are less obstructed. As has been shown quite clearly by Jones and others, the increased bronchial obstruction after ordinary gymnastic exercise is caused by increased bronchial spasm. Taking this into consideration, we can only assume that it is the movement of mucus that improves the respiratory capacity of our patients.

In most patients who have failed to improve when tested initially, subsequent tests have shown improvement. We think that this is probably due to improved muscle tone as a result of regular daily practice of these exercises, leading to more efficient clearing of the bronchial tree.

In some cases, the time of day for the exercise programme has proved significant.

Two children who failed to improve in an afternoon session, after a tiring day at school during very hot weather, showed immediate improvement at a morning session.

Moreover, we feel that the very few patients who have not yet demonstrated FEV^1 improvement after these breathing exercises will do so by persistent practice, as clinically they are already demonstrating increased exercise tolerance.

In some patients who had apparently intractable asthma, tests have been repeated as the increase in FEV^1 was beyond our expectations. Subsequent tests have confirmed our initial results. Our clinical success has been thoroughly upheld by the results of these tests.

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Commentary

The use of forced expiration in the management of asthma was the subject of much discussion by physiotherapists and had to be defended by Bernice Thompson in her paper presented at the New Zealand Society of Physiotherapists national conference in 1968 (Thompson and Thompson 1968). Forty four years on asthma management is once again the subject of attention by the profession. At the national conference held in May a paper outlining the tools to measure the control of asthma was presented by new graduates (Tucker et al 2012) and the profession launched its publicity campaign to encourage people with asthma to see a physiotherapist as part of overall management of the condition (Physiotherapy New Zealand (PNZ) 2012).

So what has happened over the past four or more decades in regard to the prevalence and management of asthma? From an epidemiological perspective asthma is now estimated to affect 30 million people worldwide (Masoli et al 2004). It is underdiagnosed, undertreated, has a direct association with obesity and is the most chronic disease in children (Global Initiative for Asthma (GINA) Executive Committee 2011). As well it is the most common cause of hospital admissions for children in New Zealand and represents a high socio-economic burden to the country (Ministry of Health 2009). Such facts confirm that GINA's strategy for asthma management and prevention is not being met and unless better asthma control is achieved the impact of this chronic disease will continue to have an unnecessary economic burden on health.

What role is there for physiotherapists in the management of this disease? Thompson and Thompson (1968) stated that the role was clear and that forced expiration was the key. Their focus was on the management of asthma in children and adolescents and the Thompsons suggested that "complete rehabilitation" depended on management "of the attack" and "between attacks", in other words a continuous regime in order to maintain well-being. Their rehabilitation included a regimen of relaxation and breathing control and forced expiration during attacks. Between attacks a graduated scheme of forced expiration and breathing control was prescribed to continue to remove mucus along with exercises that focussed on changing posture and thoracic mobility as well as postural drainage. The publicity around the management of asthma currently advocated by the profession (PNZ 2012) is focussed on breathing correctly, staying active, control of coughing and clearing mucus; perhaps a less dogmatic regime but yet it still retains an emphasis on the key themes of breathing control, clearance of mucous and exercise in order to maintain the individual's well-being.

Has there been a new discovery by physiotherapists in the approach to the management of asthma or is the justification stemming from a body of knowledge that we already have? The physiological explanation underpinning current management is not new. From the cine-radiography they undertook Thompson and Thompson (1968) were able to demonstrate the process we now understand as the dynamic compression of the airways. This compression of the airways is the basis of the flow-volume curve as explained by West (1982) during expiration. Furthermore, the technique of forced expiration is what we currently describe as the "huff". Research undertaken by physiotherapist experts in the field, namely Pryor and Webber in 1979, to evaluate the huff,

confirmed that using the huff requires less effort than a cough at the same lung volume. Importantly over the same time period more sputum is able to be cleared than without a huff and it does not increase airflow obstruction. In their paper Pryor and Webber (1979) defined the technique as "the forced expiration technique".

Such findings provide a strong evidence base for physiotherapists to include the forced expiration technique and breathing control in our practice. Asthma is currently a huge burden for global health yet it is possible for asthma to be under control (GINA Executive Committee, 2011). Let's keep physiotherapy moving by building on the evidence provided by our colleagues and using it to help our patients keep their asthma under control.

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