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BREATHING RETRAINING: EFFECT ON ANXIETY AND DEPRESSION SCORES IN BEHAVIOURAL BREATHLESSNESS

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Abstract—Thirty-six patients underwent assessment of behavioural breathlessness which included monitoring of breathing patterns and end tidal CO_2 concentration and completion of questionnaires relating to hyperventilation (HV), anxiety and depression. Twenty-two patients had a positive assessment and underwent breathing retraining. Assessments were repeated immediately after re-training and 2 months later. Ten of the patients (Group A) had behavioural breathlessness either as the primary problem or secondary to an established clinical condition, and twelve (Group B) in association with chronic fatigue. Before re-training, resting end-tidal $P_{ET}CO_2$ was significantly lower in Group A than Group B ($p < 0.05$), but there was no significant difference in mean scores for HV-related symptoms, anxiety or depression. Following breathing retraining, both groups showed improvements in breathing patterns, end tidal CO_2 levels and scores for HV-related symptoms which were sustained. In Group A the mean score for anxiety decreased ($p < 0.01$) and the score for depression was significantly lower than in Group B ($p < 0.05$). Although mean scores for anxiety and depression in Group B did not change significantly, some individuals in the group did show sustained improvement. There was no improvement in symptoms associated with chronic fatigue in Group B. In behavioural breathlessness, breathing retraining is of benefit, not only in restoring more normal patterns of breathing but also in reducing anxiety, particularly in patients without the complication of chronic fatigue.

INTRODUCTION

BREATHING in excess of metabolic requirements or hyperventilation leads to hypocapnia and respiratory alkalosis. Hyperventilation (HV) may take place chronically or in response to a provoking stimulus, such as being in a stressful environment, exercise, pain etc [1, 2]. Since cortical behavioural pathways are excessively activated by emotional disturbances, it has been suggested that behavioural breathlessness is a more appropriate title than hyperventilation syndrome for patients with this problem.

Behavioural breathlessness can induce a variable number of a wide range of symptoms including chest pain, dizziness, breathlessness, pseudoseizures, retrosternal pain, panic, weakness and depersonalization [1, 2, 4] and may cause considerable diagnostic problems [3]. Behavioural breathlessness is often secondary to or interacts with a recognized clinical condition e.g. asthma [2]. A variety of methods has been used to identify hyperventilation but no single test has been recognized as diagnostic [3, 5–7]. Therapeutic approaches range widely from simple explanation and advice to the patient through breathing retraining to cognitive therapy [3, 8, 9].

It is known that patients with behavioural breathlessness often experience anxiety or depression [3]. More recently it has been suggested that patients with chronic fatigue may hyperventilate [10] and anxiety and depression are well recognized symptoms in these patients [11].

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A substantial number of patients with suspected behavioural breathlessness are referred to the Area Respiratory Function Service, Edinburgh, each year from departments of Respiratory Medicine, Cardiology, Neurology, Infectious Diseases and Psychiatry. A standard assessment for behavioural breathlessness has been developed and a joint open trial carried out with the Physiotherapy Department both to assess the efficacy of a breathing retraining programme in a variety of patients and to determine if such training brought about any change in scores for questionnaires relating to hyperventilation, anxiety and depression.

PATIENTS AND METHODS

Ethical approval was received from the Lothian Area Ethics of Medical Research Sub-Committee for Medicine and Clinical Oncology.

Referring medical departments were encouraged to recruit patients for the open trial. Following referral, patients were seen in the Respiratory Laboratory where an initial assessment for behavioural breathlessness was carried out (see below). If this proved positive the patients were then referred to the Physiotherapy Department for assessment and breathing retraining. At the end of retraining, patients had a follow-up assessment in both departments. There was no further contact with the patients for at least 2 months when a second follow-up took place. Young people (< 18 yr) were excluded from the study.

The initial Behavioural Breathlessness Assessment was carried out by the same clinical scientist (PT) and comprised:

A clinical history: completion by patient of Nijmegen questionnaire for symptoms relating to hyperventilation [6] and Self-Rating Scale of Distress, sub-scales for anxiety and depression [12]; a check-list of the 'minor' symptoms used in a working case definition of chronic fatigue syndrome [13] and a check-list of feelings of depersonalization (modified from Ref. [14]); other symptoms experienced by the patient were clarified and any symptoms present at the time of the assessment were noted. Tests included: spirometry (forced expiratory volume in 1 sec (FEV_1), vital capacity (VC) and the FEV_1/VC ratio using a dry bellows spirometer); a hyperventilation provocation test; breath-hold time (from the top of a 'satisfactory' breath in). The patients also estimated their exercise capacity on 'good' and 'bad' days using the O_2 diagram [15].

The hyperventilation provocation test was based on the method of Hardonk and Beumer [5] which involves successive 3 min periods of resting breathing, voluntary hyperventilation and recovery. A closed circuit spirometer with chart recorder was used to record breathing pattern and end-tidal ($ETCO_2$) concentration (%) was recorded using a rapid response infra-red analyser and chart recorder. After the test patients were asked about any symptoms or change in intensity of existing symptoms which they had experienced. If a patient became distressed during resting breathing, recording was stopped after 3 min.

The assessment was completed with an explanation of the tests which had been carried out. There was additional discussion with those patients shown to have behavioural breathlessness during which the relationship between breathing, hypocapnia and symptoms was explained. This was illustrated by the patient's own records of breathing pattern and $ETCO_2$, and tracings from a normal subject.

Behavioural breathlessness was considered to be present if the patient's symptoms were induced by the test procedures or if hypocapnia, taken as $ETCO_2$ consistently below 4.2% [2] was demonstrated during resting breathing. Patients with a positive assessment were then referred to the Physiotherapy Department to undergo breathing retraining.

The breathing retraining programme was carried out by the same physiotherapist (IR). Initial assessment included: clinical details; identification of triggering situations; observation of breathing pattern (including upper chest or abdominal breathing, nasal or oral breathing, presence of sighing, gulping or yawning, inappropriate pattern during speech) with the patient both seated and lying [9, 16]; further explanation of the effects of HV in relation to the patient's own symptoms and the need for commitment. Training took place over a number of visits and included: developing patient's awareness of their breathing pattern, individualized breathing exercises and implementation of breathing control during speech, daily routine and exercise. Treatment in the short term was aimed at developing control in triggering situations and in the long term in achieving an effortless breathing pattern [16]. Visits took place initially once per week extending gradually to every 2 or 3 weeks.

Follow-up assessments

The first follow-up took place on completion of the breathing retraining programme and the second 2 months later. The patient attended both the Respiratory Laboratory, where all parts of the behavioural

breathlessness assessment (except simple spirometry) were repeated, and the Physiotherapy Department. Results were compared in both places with previous visits and positive encouragement was given.

The results were analysed using one-way ANOVA with the Kruskal–Wallis test and the Kolmogorov–Smirnov two-sample test.

RESULTS

Thirty-six adults with suspected behavioural breathlessness were referred for assessment over an 8-month period, twenty-four of whom were from the Regional Infectious Diseases Unit and the remainder from Respiratory or Cardiology Units. Twenty-two patients who satisfied the criteria for behavioural breathlessness underwent the breathing retraining programme. Ten patients presented with hyperventilation either as the sole presenting problem or secondary to a well established clinical disorder, Group A (Table I) and twelve presented with chronic fatigue and hyperventilation, Group B. All the patients in Group B had been referred from the Regional Infectious Diseases Unit. The mean ages of the Groups [Group A: 40 yr (SD 14) Group B: 38 yr (SD 10)] did not differ significantly and the sex distribution was the same in both Groups (Group A: five female, Group B: six female).

Only two patients were found to have an abnormality on spirometry, A3 having a mild obstructive ventilatory defect and A9 a moderate restrictive ventilatory defect. Both of these findings were consistent with the underlying clinical condition.

Findings before breathing retraining

The breathing patterns (both observed by IR and recorded by PT), $ETCO_2$ levels and scores relating to hyperventilation (Nijmegen questionnaire, [6]) and self-rating scales for anxiety and depression (Self-Rating Scale of Distress, [12]) for the twenty-two patients with behavioural breathlessness prior to breathing retraining are shown in Table II.

Performance of the test procedures resulted in all but one patient (A1) experiencing symptoms of which they had previously complained or a worsening of their symptoms. Three patients in Group A were unable to tolerate a mouthpiece; ventilation was not recorded but $ETCO_2$ was measured using a sample line at the base of a nostril. One patient in Group A and two patients in Group B panicked while breathing through the mouthpiece at rest and recordings were stopped after 3 min. The majority of patients in Group A demonstrated hypocapnia during resting breathing in contrast to the patients in Group B ($p < 0.05$). End tidal CO_2 following the hyperventilation provocation test was significantly lower in Group A ($3.5\% \pm 0.38$) than Group B ($4.1\% \pm 0.70$) ($p < 0.01$).

Scores for the Nijmegen questionnaire for HV-related symptoms were positive (≥ 26) in sixteen (73%) of the patients (Table II). There were three exceptions in Group A (A1, A3 and A10) and three in Group B (B4, B7 and B11). The mean scores for Groups A and B were not significantly different.

Scores for anxiety [12] were (> 7) in seventeen patients (Table II). There was no significant difference between the mean scores for anxiety in Groups A and B. Scores for depression were raised (> 7) in thirteen patients but the differences between the number of patients with raised scores in Groups A and B and the mean scores for the Groups did not achieve statistical significance.

The presence of eight or more of the 'minor' symptoms from the Working Case

TABLE I.—PATIENT DETAILS

Group and patient number	Occupation	Age	Sex	Clinical background	Follow-up Attendance 1st	2nd
A 1	Book-keeper (part-time)	63	F	Previous mastectomy	Y	N
2	Ex. lorry driver	44	M	Arthritis, Crohns Disease	Y	Y
3	Nursing sister	46	F	Asthma	N	N
4	Policeman	25	M	Prostatitis, Pulm. emb.	Y	Y
5	Bank clerk	21	F	Asthma	Y	N
6	Hairdresser	35	F	None	Y	Y
7	Heavy goods engineer	54	M	None	Y	Y
8	Ex. receptionist	54	F	SLE, Asthma	N	N
9	Ex. fisherman	55	M	Cor artery graft	Y	Y
10	Computer operator	21	M	None	Y	Y
B 1	Head teacher	43	F	Suspected viral infection	Y	Y
2	Ex. Head teacher	39	M	Viral infection	Y	Y
3	Lecturer	37	M	Viral infection	Y	Y
4	Housewife	36	F	Viral infection	N	N
5	Clerk of court	33	M	Viral infection	Y	Y
6	Student	21	F	Lyme disease	Y	Y
7	Retired teacher	59	F	Suspected viral infection	Y	Y
8	Community worker	25	F	Viral infection	N	N
9	Managing director	41	M	Viral infection	Y	Y
10	Architect	35	M	Viral infection	Y	Y
11	Scientist	42	M	Viral infection	Y	Y
12	Civil servant	39	F	Viral infection	Y	Y

TABLE II.—ASSESSMENT RESULTS PRIOR TO BREATHING RETRAINING

Group and patient number		Breathing Pattern			End Tidal CO_2 (%) Resting	Symptoms from test procedures	Questionnaire Scores		
		Observed by IR when recumbent	Recorded by PT Tidal volume	Breath frequency			HV	Anxiety	Depression
A	1	UC MB S Y Sp	ø	Normal	3.9	No	19	10	7
	2	UC MB Sp	ø	Fast	4.1	Yes	26	10	18
	3	UC N Sp	Increased	Normal	4.0	Yes	18	7	4
	4	UC N S	Normal	Normal	4.7	Yes	29	20	9
	5	A MB	Reduced	Fast	3.9	Yes	26	7	7
	6	UC N	Increased	Fast	3.6	Yes	29	12	7
	7	UC MB G Sp	Irregular	Slow	5.1	Yes	35	10	3
	8	UC MB Sp	ø	Fast	4.1	Yes	55	17	12
	9	UC MB Y Sp	Irregular	Fast	3.7	Yes	37	11	4
	10	UC N Y Sp	Reduced	Fast	3.7*	Yes	24	15	13
Mean					4.1		29.8	11.9	8.4
SD					0.47		10.7	4.2	4.7
B	1	UC N S	Reduced	Fast	4.1	Yes	32	11	4
	2	UC N S	Irregular	Fast	5.2	Yes	41	16	16
	3	A N S	Irregular	Normal	4.7	Yes	35	9	4
	4	A N S	Irregular	Normal	4.7	Yes	11	1	9
	5	UC MB Sp	Increased	Fast	3.9*	Yes	35	14	10
	6	UC N	Irregular	Normal	5.8	Yes	38	19	8
	7	A N S	Irregular	Irregular	3.9*	Yes	14	11	14
	8	UC N S	Irregular	Normal	4.7	Yes	34	14	16
	9	UC N S Sp	Increased	Normal	5.0	Yes	27	4	15
	10	UC N S Sp	Irregular	Fast	5.1	Yes	37	21	18
	11	A N Y	Increased	Slow	4.9	Yes	9	4	3
	12	UC N S	Irregular	Fast	3.8	Yes	45	12	13
Mean					4.7		29.8	11.3	10.8
SD					0.62		12.0	6.1	5.2

UC = continuous or occasional upper chest movement. A = predominantly abdominal breathing. MB = mouth breather. N = nasal breathers. S = sigh. G = gulp. Y = yawn. Sp = inappropriate breathing pattern during speech. ø = No ventilation recording, nasal $ETCO_2$ only available.

*Formal HV not performed.

definition of the chronic fatigue syndrome [13] is considered to support the diagnosis of CFS and this was found in nine patients. The difference between Group A (one patient) and Group B was significant ($p < 0.01$). Feelings of depersonalization were admitted by seven patients, three in Group A (A6, A7, A10) and four in Group B (B1, B3, B9, B10).

Subjective estimates of exercise capacity using the O_2 cost diagram [15] showed little difference between patients on 'good' days, both Groups A and B showing a range from the equivalent of medium walking on the level to brisk walking uphill. There was little variation in exercise capacity between 'good' and 'bad' days in Group A but in Group B was markedly less on a 'bad' day, ranging from the equivalent of standing to slow walking uphill.

Breath-hold time varied widely ranging from 7 to 45 sec in Group A and 8 to 65 sec in Group B, ranges very similar to that reported by Jones and Scarisbrick [17] in patients with effort syndrome. Two of the patients in Group A (A1 and A8) and three in Group B (B3, B5 and B7) were unable to hold their breath for more than 10 sec and each of these patients experienced one or more of their symptoms after the attempt.

Observations on breathing pattern made during the initial physiotherapy assessment are given in Table II. Disproportionate upper chest movement was observed in the majority of patients. Mouth breathing occurred most frequently in Group A with evidence of yawning, gulping and inappropriate breathing patterns during speech. Sighing was most commonly observed in Group B [9]. Recordings of ventilation confirmed that breathing patterns were largely abnormal [18].

Follow-up assessments after breathing retraining

The mean number of visits to the physiotherapist for breathing retraining was seven ranging from three for those who discontinued the programme to fourteen for those requiring more assistance. The period over which therapy was carried out ranged from 3 to 14 wk respectively.

Eighteen of the twenty-two patients completed the breathing retraining programme and underwent the first follow-up assessment. One patient (B8) failed to complete the programme because of poor compliance, two (A8 and B4) because of deterioration in clinical condition and one (A3) because of both an increase in personal stress factors and poor compliance. Of the eighteen patients, sixteen returned for the second follow-up assessment 2 months after completion of breathing retraining programme. One patient, A5 failed to attend, and A1 did not attend because of an administrative failure.

Details of resting $ETCO_2$ levels and scores for the hyperventilation, anxiety and depression questionnaires for the first and second follow-up visits are given in Table III.

At the first follow-up assessment, resting $ETCO_2$ levels rose in all cases, only one patient in Group A (A6) and one in Group B (B7) continuing to show hypocapnia. At the second follow-up assessment all patients had resting $ETCO_2$ levels in the normal range and there was no significant difference between the two groups. The overall increase in resting $ETCO_2$ was significant for both Groups A and B ($p < 0.001$). Mean $ETCO_2$ following the hyperventilation provocation test rose to 4.4% SD 0.8 in Group A and 5.0% SD 0.7 in Group B at first follow-up and to 5.4% SD

TABLE III.—FIRST AND SECOND FOLLOW-UP (FU) ASSESSMENT RESULTS

Group and patient number		Symptoms from test procedures		End Tidal CO_2 (%) Resting		Questionnaire Scores					
						HV		Anxiety		Depression	
		1st FU	2nd FU	1st FU	2nd FU	1st FU	2nd FU	1st FU	2nd FU	1st FU	2nd FU
A	1	Yes	—	4.4	—	9	—	6	—	4	—
	2	No	No	4.6	4.8	19	19	9	6	12	13
	3	—	—	—	—	—	—	—	—	—	—
	4	Yes	No	5.0	6.2	15	10	8	3	2	3
	5	No	—	4.6	—	8	—	0	—	1	—
	6	Yes	No	3.8	5.1	3	8	4	5	1	4
	7	Yes	No	5.6	6.0	31	24	2	9	4	5
	8	—	—	—	—	—	—	—	—	—	—
	9	No	No	5.3	5.6	32	43	11	10	8	4
	10	No	No	5.3	6.2	12	8	1	0	3	0
Mean				4.8	5.6	16.1	18.6	5.1	5.5	4.4	4.8
SD				0.58	0.59	10.6	13.6	4.0	3.7	3.8	4.3
B	1	No	No	5.1	6.1	29	20	10	7	7	2
	2	No	No	5.5	5.0	34	21	13	10	13	12
	3	No	No	5.0	6.3	17	16	5	3	3	4
	4	—	—	—	—	—	—	—	—	—	—
	5	No	No	5.4	6.1	14	22	10	7	6	7
	6	No	No	5.8	5.9	34	18	15	13	9	7
	7	No	No	3.7*	5.6	17	17	5	10	11	21
	8	—	—	—	—	—	—	—	—	—	—
	9	No	No	5.5	5.8	15	11	9	5	13	9
	10	No	No	5.3	6.2	32	32	17	17	15	15
	11	No	No	6.2	6.7	7	3	3	2	4	2
	12	No	No	4.3	4.9	25	2	7	7	10	10
Mean				5.2	5.9	22.4	16.2	9.4	8.1	9.1	8.9
SD				0.72	0.59	9.6	9.0	4.6	4.6	4.0	6.0

— = Did not attend, *Formal HV not performed.

0.8 in Group A, and 5.2% SD 0.9 in Group B at second follow-up. These overall changes were significant for both Groups ($p < 0.01$). At the first follow-up assessment one patient (B7) panicked during resting breathing on the mouthpiece but then 'took control' and $ETCO_2$ then rose to the normal range. This patient had no difficulty at second follow-up. At the first follow-up visit four patients in Group A continued to report symptoms as a result of the test procedures but all were symptom-free at second follow-up. No patients in Group B experienced symptoms as a result of the test procedures at either follow-up assessment.

The majority of patients showed a decrease in scores for the Nijmegen questionnaire at follow-up. The difference in mean scores was significant for both Groups ($p < 0.05$). Only two patients in Group A (A7 and A9) showed significant scores at the first follow-up and one patient (A9) had a raised and worse score in association with worsening clinical problems at second follow-up. Four patients in Group B had positive scores at first follow-up and only one (B10) at second follow-up.

Scores for anxiety following breathing retraining differed in the two groups. There was a significant decrease in Group A, which was maintained at the second follow-up assessment ($p < 0.01$) but there was no overall change in the anxiety scores for Group B. Although there was a decrease in mean scores for depression in Group A at first follow-up which was largely maintained at second follow-up, overall this did not achieve significance. However, the mean score for depression in Group A was significantly lower post-treatment compared to Group B ($p < 0.05$). There was no significant change in the scores for depression in Group B post-treatment.

At follow-up the number of 'minor' symptoms associated with chronic fatigue in Group A remained low or decreased further. In Group B, the number of 'minor' symptoms remained high, only B9 showing and maintaining a reduction from 8 to 4. Of the patients who had feelings of depersonalization prior to breathing retraining, two of the three in Group A (A6, A10) and one of the four in Group B (B3) showed and maintained improvement at follow-up.

During the first and second physiotherapy follow-up assessment all patients demonstrated nasal breathing and all but patient B12 showed primarily abdominal breathing (Table III). No sighing was observed except in patient B12 and no gulping or yawning but five patients (A2, A7, B5, B9 and B10) continued to show evidence of inappropriate breathing patterns during speech. Ventilation recordings made during the follow-up respiratory assessments gave supporting evidence that the patients were able to implement the breathing control which they had been taught. The majority showed normal depth and frequency during resting breathing on the mouthpiece but two patients (B1 and B9), however, showed regular breathing, but with slow and deep breaths.

Subjective estimates of exercise capacity showed little change post-treatment in Group A. In Group B there was little change on 'good' days but the difference between exercise capacity on 'good' and 'bad' days tended to decrease although this did not achieve significance for the group as a whole. Breath-hold times for the five patients who had been unable to achieve more than 10 sec at the initial assessment rose by 8–20 sec at first follow-up (so that no patient retained values less than 10 sec) and this improvement was maintained at second follow-up.

DISCUSSION

Patients referred for this study were suspected by the referring clinicians to have behavioural breathlessness. However, fourteen of the thirty-six patients failed to satisfy the criteria for a positive assessment.

The assessment for behavioural breathlessness which we used requires measurement of respiratory function and this makes it difficult to compare a treatment and control group without introducing some awareness of respiration in the control group. It was therefore decided to run an open trail, all the patients undergoing the breathing re-training programme. Any learning or placebo effects created by the assessments and training programme might be expected to occur regardless of whether the patient had breathlessness as the primary problem or secondary to a well recognized clinical disorder (Group A) or as part of the chronic fatigue syndrome (Group B).

Breathing on a mouthpiece with a noseclip is known to affect ventilation but the procedure does not give rise to hyperventilation related symptoms or to hypocapnia [18] in patients without behavioral breathlessness. The procedure was used as a form of stress and if the patient showed HV it was considered an indication of the likely form of response when the patient was in other stressful situations.

Patients found the recordings of breathing pattern easy to understand and the tracings were therefore an invaluable aid in the training process. In contrast, the traces of $ETCO_2$ were less easily understood by the patients and these were therefore used largely for diagnostic rather than education and training purposes.

The results show that Group A (i.e. patients with hyperventilation as a sole presenting factor or secondary to a well established clinical disorder) received considerable benefit from breathing retraining. Observed breathing habits improved, $ETCO_2$ rose and HV related symptoms decreased as shown both by questionnaire and in response to testing. There was a significant decrease in scores relating to anxiety. Scores relating to depression were also decreased when compared with patients in Group B. All of these improvements were maintained for at least 2 months after cessation of the training programme. As a whole, Group A patients were pleased with their progress.

As a group, the patients with chronic fatigue showed less severe hypocapnia before treatment than those in Group A and several had already shown both nasal and abdominal breathing. The major benefit from breathing retraining in Group B was largely confined to an increase in $ETCO_2$ and a reduction in symptoms during the test procedures. The scores for the Nijmegen questionnaire (for HV) took longer to decrease in Group B than in Group A, statistical significance only being achieved by the second follow-up assessment. Although in four patients scores for both anxiety and HV returned to the normal range following breathing retraining (B3, B5, B9, B12), the change in the mean score for anxiety in Group B did not achieve significance. In only one patient (B5) did the score for depression return to the normal range following breathing retraining.

Following breathing retraining, and in spite of improvement of $ETCO_2$ and HV scores, there was no consistent improvement in the scores for minor symptoms of chronic fatigue. Only one patient (B9) showed reduction in fatigue. HV would not, therefore, appear to have been a major causal factor for fatigue in Group B. It is

possible that the HV was an expression of the frustration and the feelings of lack of control described by these patients.

The idea has been expressed that only patients who are anxious and hyperventilating develop depersonalization [19]. Seven patients in our study experienced feelings of depersonalization. Following breathing retraining, three of these patients ceased to have such feelings, implying a link with HV [19], but the other patients continued to experience depersonalization, in spite of $ETco_2$ and response to HV and questionnaire scores for HV being normal and even when anxiety scores also became normal. This suggests that the feelings in the latter patients may have been a reflection not of HV but of a depersonalization disorder.

It had been hoped that the use of the oxygen cost diagram would enable comparison of subjective estimates of exercise tolerance between assessments particularly in the patients with chronic fatigue. In fact, the tendency of the latter patients to reduce their activity levels when they felt unwell made the use of this scale unhelpful in these patients.

Our experience indicates that for therapist's time to be used effectively, patients must be selected for breathing retraining. Demonstration of HV alone is not enough. For patients presenting with chronic fatigue we now believe it is important to demonstrate not only hypocapnia at rest (prior to voluntary HV) but also high scores for HV, as well as generation of symptoms following voluntary HV. In any patient, if there is either resistance to the idea of breathing being related to symptoms, or lack of commitment to regular performance of breathing exercises or unwillingness to check out breathing patterns and exercise control during daily activities, breathing retraining is unlikely to be of benefit.

This study has important implications for the treatment of patients with chronic fatigue. In the patients who were shown to have behavioural breathlessness, we were able to relieve the symptoms associated with HV by breathing retraining but only in a minority did this relief improve anxiety scores. Application of more stringent selection criteria will help to identify the patients who are likely to receive most benefit from breathing retraining. In our patients breathing retraining did not appear to have a direct effect on fatigue. The significance of the severity of anxiety and depression scores on the outcome of breathing retraining is currently being investigated further.

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