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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

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Breathing pattern disorder in difficult asthma: Characteristics and improvement in asthma control and quality of life after breathing re-training

To the Editor,

Breathing pattern disorder (BPD), or dysfunctional breathing, encompasses heterogeneous disorders characterized by abnormal breathing patterns resulting in symptoms that mimic asthma.¹ BPD affects 24%-29% of patients with asthma and 30%-64% of patients with difficult asthma.¹⁻⁴ Diagnosis is generally based on Nijmegen score, a questionnaire that detects hyperventilation, just one BPD form.^{1,4,5} Difficult asthma is distinct from severe asthma,⁶ and patient factors including comorbidities such as BPD are thought to be particularly important in patients with difficult asthma.

In primary care, breathing retraining for patients with asthma improves quality of life (QOL).⁷ Patients with difficult asthma present a much greater health burden, and BPD is independently associated with worse asthma control and QOL; therefore, treatment may deliver a greater benefit.⁸

This study, in patients with difficult asthma, examines BPD characteristics and reports outcomes following breathing retraining.

We undertake systematic evaluation for difficult asthma, where patients with suspected BPD undergo a multidimensional physiotherapist assessment. Ethics approval was obtained (HREC 185/15); requirement for informed consent was waived.

Nijmegen, Asthma Control Test (ACT), and Asthma QOL Questionnaire (AQLQ) were administered at baseline and 6 months. Asthma exacerbations were defined as ≥ 3 days systemic corticosteroids. Inhaler technique and adherence were assessed and optimized.

Asthma comorbidities were sought; allergic rhinitis—symptoms and atopy; chronic rhinosinusitis—clinical symptoms with abnormal sinus CT or rhinological examination; anxiety and depression—physician diagnosis or elevated Hospital Anxiety and Depression score (HADS); and vocal cord dysfunction—paroxysmal vocal cord movement on nasoendoscopy.

Patients with suspected BPD were assessed by a specialized physiotherapist for mouth breathing, thoracic dominance, hyperventilation (elevated respiratory rate at rest), thoraco-abdominal asynchrony, accessory muscle use and musculoskeletal abnormalities. Breathing retraining was delivered over one or more sessions. A

general therapeutic approach comprised promotion of abdominal and nose breathing, postural training, relaxation and feedback to consciously decrease the respiratory rate tailored to individual BPD features detected at assessment.

Of 109 consecutive patients assessed between June 2015 and December 2017, 35 underwent BPD evaluation. Twenty-nine of 35 patients were diagnosed with BPD (patient characteristics Table 1). Twenty-five had documented variable airflow obstruction (Table 1); three had a clinical asthma diagnosis, and one had fixed airflow obstruction (never smoker).

The mean number (and standard deviation) of exacerbations in the prior 6 months was 3.1 ± 2.3 ; ACT score, 13.1 ± 4.3 ; AQLQ score, 3.9 ± 1.1 ; and reliever use over 7 days, 24 ± 43 actuations.

TABLE 1 Baseline demographic data

Age (mean $\pm$ standard deviation)	49 $\pm$ 12 years
Sex (% female)	59%
BMI (mean $\pm$ standard deviation)	31 $\pm$ 6.7 kg/m ²
FEV1% predicted (mean $\pm$ standard deviation)	71 $\pm$ 22
Variable airflow obstruction	25/29 (86%)
Bronchodilator reversibility	16/29 (55%)
Peak flow variability	6/29 (21%)
Bronchial hyperreactivity	3/29 (10%)
Years since asthma diagnosis (mean $\pm$ standard deviation)	30 $\pm$ 17.8
Serum eosinophils (mean $\pm$ standard deviation)	0.19 $\pm$ 0.16 $\times 10^9$ /L
Total IgE (mean $\pm$ standard deviation)	428 $\pm$ 997 kU/L
Smoking status (%)	
Never	69
Ex	24
Current	7
Employed	59%

Comorbidities were frequent: allergic rhinitis in 38%, chronic rhinosinusitis in 48%, anxiety/depression in 62% and vocal cord dysfunction in 31%.

Mean baseline Nijmegen score was 28.8 ± 12 , and 7/29 (24%) patients had normal scores (<24). The commonest BPD characteristic was thoracic dominance (83%), with prominent excursion of the upper chest at rest rather than the abdomen, a highly inefficient method of breathing. Hyperventilation was present in 45%; mouth breathing, 28%; accessory muscle use at rest, 24%; spinal abnormalities, 10%; abnormal neck position, 10%; and thoraco-abdominal asynchrony, 3.5%. There was considerable BPD characteristic overlap (Figure 1).

Following breathing retraining, of the 23 patients with pre- and post scores available, mean Nijmegen score improved significantly from 30 to 21 ($n = 23$, $P < 0.001$): 21 improved, one remained stable, and one worsened. 11/23 patients normalized their initially elevated scores. 10/23 were "super-responders" (>10 point improvement), and not all of these patients had elevated scores initially. Physiotherapy assessment revealed improved breathing technique in most patients.

Among patients with available post-treatment scores, there were significant improvements in mean ACT (13-16, $n = 21$, $P = 0.018$) and AQLQ (from 3.9 to 4.7, $n = 25$, $P = 0.001$), but not in anxiety (HADS-A; 8.3 to 8.9, $n = 20$, $P = 0.44$) nor depression scores (HADS-D; 6.2 to 6.8, $n = 21$, $P = 0.28$). Exacerbations decreased significantly from 2.8 to 1.4, $n = 17$, $P = 0.006$. This was despite there being no significant change in FEV1 following breathing re-training ($n = 27$, $P = 0.81$). Negative or positive baseline Nijmegen score did not impact on these improvements.

This study of patients with difficult asthma and BPD demonstrates substantial disease heterogeneity and BPD characteristic overlap. Thoracic dominant breathing was the commonest BPD

pattern, but this often co-existed with hyperventilation and mouth breathing. Postural and musculoskeletal abnormalities were also seen in this population and may contribute to BPD development. There was a mean 30 years since asthma diagnosis among our patients, and this may be an important factor in the development of BPD.

Individuals with asthma often have residual symptoms despite optimal pharmacological therapy. BPD may account for some of these residual symptoms and associated disease burden.⁹ Breathing retraining improves QOL in individuals with asthma.⁷ Among our patients with difficult asthma, the majority responded to breathing retraining by a specialized physiotherapist. Following breathing re-training, there were significant improvements in asthma control, QOL, Nijmegen scores and fewer asthma exacerbations. There was also a visible improvement in breathing techniques in most patients. Mood disorder was common in this group; however, there was no specific treatment for anxiety or depression administered during the study period. The benefits of breathing re-training in BPD do not appear to be modulated by improvements in depression or anxiety, as the HADS scores remained static.

A quarter of our patients with physiotherapist-confirmed BPD had normal baseline Nijmegen scores, indicating that more sensitive diagnostic tools are needed to detect other forms of BPD in addition to hyperventilation.

These data are attended by the usual constraints of an uncontrolled single-arm observational study. Questionnaire follow-up was incomplete, raising the possibility of bias when assessing response to treatment. BPD assessment was undertaken by a single specialized physiotherapist, and therefore, inter-rater reliability is not available. Three patients had a clinical asthma diagnosis and may have been misclassified. This is a highly selected population, and therefore, results are not applicable to a general asthma population. Some BPD characteristics may represent maladaptive learned responses to airways obstruction; nevertheless, as we have shown they are responsive to therapy we feel that it is important to recognize and treat these characteristics.

In conclusion, BPD was common in a difficult asthma cohort, and there was a significant overlap of different BPD characteristics. In this patient group, breathing retraining was effective therapy for BPD, associated with improvements in asthma outcomes.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

Keywords

asthma, breathing pattern disorder, breathlessness, difficult asthma, dysfunctional breathing, severe asthma

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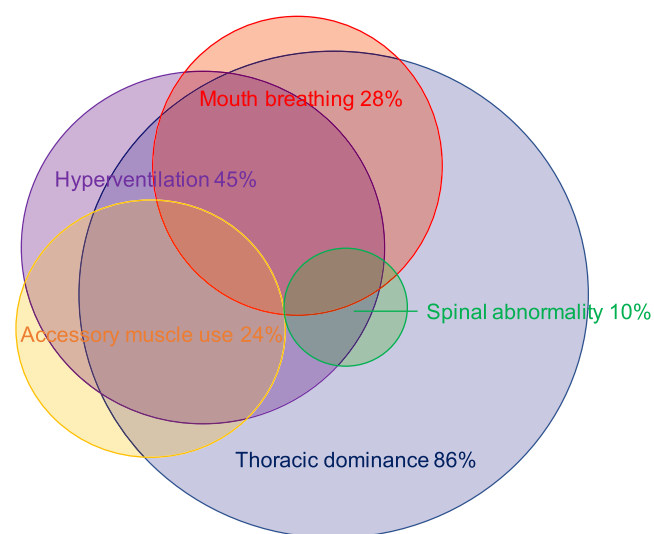


FIGURE 1 Breathing pattern disorder characteristics overlap significantly in patients with difficult asthma [Colour figure can be viewed at wileyonlinelibrary.com]

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