Respiratory Medicine 123 (2017) 42–47

Contents lists available at ScienceDirect

Respiratory Medicine

journal homepage: www.elsevier.com/locate/rmed

The impact of dysfunctional breathing on the assessment of asthma control

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ARTICLE INFO

Article history:
Received 13 September 2016
Received in revised form
23 November 2016
Accepted 16 December 2016
Available online 18 December 2016

Keywords:
Dysfunctional breathing
Asthma
Nijmegen questionnaire
Asthma control

ABSTRACT

Background and objective: Dysfunctional breathing (DB) is a respiratory disorder, which involves a pattern of breathing too deeply, too superficially and/or too rapidly. In asthma patients, DB may lead to an overestimation of the severity of asthma symptoms, and hence potentially to overtreatment. However, it is not known to which degree DB may affect estimates of asthma control, in a specialist clinical setting.
Methods: The MAPOut-study examined all patients referred consecutively over a 12-months period for specialist assessment of asthma at the Respiratory Outpatient Clinic at Bispebjerg Hospital in Copenhagen. All patients were examined with the Nijmegen questionnaire with a DB defined as a score $\geq$23 and the ACQ questionnaire. Linear regression analysis of predictors of ACQ score was performed. Asthma was defined as asthma symptoms and a positive asthma test.
Results: Of the 256 patients referred to the lung clinic, data on both the Nijmegen questionnaire and ACQ score was obtained in 127 patients, who were included in the present analysis. Median (range) age: 30 (15–63) years, and 76 (59.8%) were females. DB was found in 31 (24.4%). Asthmatic patients with co-existing DB had a poorer asthma control compared to asthmatics without DB (Median (range) ACQ score: 2.40 (0.20–4.60) vs 1.20 (0.00–4.40); $p < 0.001$.). A regression analysis showed that the effect of DB on asthma control was independent of airway hyperresponsiveness or airway inflammation in patients with DB.
Conclusion: Dysfunctional breathing is common among asthma patients in a specialist setting, and results in a clinically significant underestimation of asthma control, which may potentially lead to overtreatment.

1. Introduction

Assessment of symptom control is a key element in asthma management, as the level of asthma control reported by the patient, guides up- and down-titration of treatment [1]. Standardized questionnaires have been developed to enable systematic and repeated assessment of asthma control within patients, as well as comparison between patient groups [2–4].

However, respiratory symptoms in asthma may reflect other, co-existing conditions or co-morbidites, such as obesity, gastro-esophageal reflux disease, deconditioning, anxiety, depression or dysfunctional breathing [1,5].

Dysfunctional breathing (DB) is a respiratory disorder, which is defined as chronic or recurrent changes in breathing patterns that cannot be attributed to a specific medical diagnosis. Symptoms of DB include dyspnea, exercise-induced breathlessness, deep sighing, frequent yawning and hyperventilation leading to hypocapnia, causing respiratory and non-respiratory complaints such as fatigue, light headedness and anxiety. Because patients frequently over-breathe or have an increased respiratory rate, this syndrome is often called the hyperventilation syndrome (HVS), which is the same as DB. Apart from this clinical characteristic, there is no golden standard for the diagnosis of dysfunctional breathing [6–8].

Dysfunctional breathing is relatively common, with a prevalence in adults in the community reported to be around 8% [9]. In asthma patients it is even more frequent with a prevalence of approximately one third in female asthma patients and one fifth of male asthma patients [10]. However, the prevalence of DB among asthma patients referred for specialist care is largely unknown, as most studies have examined selected patient groups.

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http://dx.doi.org/10.1016/j.rmed.2016.12.008
0954-6111/

It is known that asthmatic patients with DB have lower quality of life scores, higher prevalence of anxiety and a lower sense of coherence compared to patients without DB [11,12]. However it is not known to which degree DB may affect estimates of asthma control in a specialist clinic setting.

Dysfunctional breathing may be assessed objectively by progressive exercise testing, which assesses the ventilation pattern during exercise [12] or a hyperventilation provocation test (HVPT), demonstrating an excessive fall in arterial CO_2 during hyperventilation [13]. As these tests are time-consuming and requires access to appropriate test facilities, they are not feasible for screening for DB in an everyday clinical setting. The Nijmegen questionnaire was developed for this purpose, and is commonly used in asthma studies to assess the prevalence of DB [14].

DB can co-exist with respiratory diseases such as asthma but no technique has yet been validated to identify DB in the presence of asthma. In a report from 2008 it is suggested that the combination of Nijmegen questionnaire as a screening tool followed by progressive exercise testing might increase the diagnostic specificity for the identification of DB in asthma patients [12].

Given that dysfunctional breathing is frequent in asthma, and may result in an overestimation of severity of asthma symptoms, which can lead to overtreatment [6], it is important to understand the level of impact that DB may have on asthma symptom control.

Hence, the aim of this study was to determine the prevalence of DB, defined as a score of ≥23 on the Njmegen questionnaire, among patients referred for specialist care for asthma and to evaluate the impact of DB on the level of asthma symptom control.

2. Methods and material

2.1. Design

The MAPOut II study is a cross-sectional study of all patients referred consecutively over a 12-months period for specialist assessment of asthma at the Respiratory Outpatient Clinic at Bispebjerg Hospital in Copenhagen. We recruited among patients either suspected of asthma or known asthma. The exclusion criteria were; age <15 years, respiratory diseases other than asthma (eg, chronic obstructive pulmonary disease, sarcoidosis), individuals older than 40 years with a smoking history of more than 10 pack-years, recent respiratory infection (<6 weeks) and pregnancy. The reasons for excluding individual older than 40 years with a smoking history of more than 10 pack-years from the study is, that we wanted to make sure the subjects didn't have other lung diseases e.g. COLD. Patients younger than 40 years with asthma symptoms and tobacco consumption more than 10 pack-years, were eligible for the study. Enrollment of patients took place between March 2011 and April 2012.

Over the 12-months period, a total of 256 subjects were referred for the assessment of suspected or known asthma. A total of 190 patients participated in the study, equivalent to 80% of the population eligible for inclusion in the study. The study was approved by the local ethical committee (H-3-2011-121).

3. Material

Of 256 patients, 190 subjects wanted to participate and 151 had asthma symptoms as well as a positive asthma test and were concluded to have asthma, in accordance with the criteria of asthma. There were 127 subjects who had completed both the Nijmegen Questionnaire and the Asthma Control Questionnaire and they were included for further analysis (Fig. 1).

All subjects had a 3-day asthma evaluation program within a 14-day period. On the first visit a spirometry including a reversibility test after 4 puffs of terbutaline (2 mg) was performed. The second visit included FeNO measurement, bronchial challenge with methacholine and a skin prick test with 10 standard allergens. The third and last visit included mannitol bronchial provocation Fig. 2.

All participants were interviewed using a questionnaire based on the GINA guidelines, and filled in a number of self-administered questionnaires including Nijmegen Questionnaire, Asthma control Questionnaire (ACQ-5) and Quality of Life Questionnaire (mini-AQLQ) [15].

3.1. Definition of asthma

Subjects were defined as having asthma when they had symptoms suggestive of asthma, and either at least one objective marker of variable airflow obstruction (peak-flow variability [PEF (max-min/max) *100 ≥ 20%] or reversibility to beta-2-agonist [≥12% and at least 200 mL], AHR to either methacholine (PD20 ≤ 8 mmol) or mannitol (PD15 ≤ 635 mg). Furthermore, a doctor's diagnosis of asthma and current use of inhaled corticosteroids, as these patients could have a negative test panel, in spite of having asthma.

3.2. Dysfunctional breathing and asthma control

The Nijmegen questionnaire was used to assess the presence of dysfunctional breathing (Table 1). The Nijmegen Questionnaire assesses 16 symptoms associated with abnormal breathing, using a five-point scale (1 = never, 5 = very often). A total symptom score of ≥23 has been reported as showing a high sensitivity (91%) and specificity (95%) in recognizing patients with DB [14]. DB was defined as a score on the Nijmegen questionnaire of ≥23. Poor asthma control was defined as a score on the ACQ of >1.5. The minimal clinically important difference (MCID) for the ACQ score is 0.5.

3.3. Exacerbation

An exacerbation was defined according to GINA criteria, as any self-reported worsening in the participant's asthma symptoms during the last 12 months in the interview [1].

3.4. Self-estimated asthma severity

The self-estimated asthma severity was defined as the score on the visual analogue scale (VAS) before bronchial challenge with mannitol.

3.5. Threshold of dyspnea

The threshold of dyspnea was defined as the score on the visual analogue scale (VAS)/percent fall in FEV1 after bronchial challenge with mannitol.

3.6. Spirometry

Lung function was performed using maximum expiratory flow volume according to the standards specified by the ATS and ERS [16], using EasyOne (Spiropharma®). Predicted normal values based on weight, height and age were calculated using NHANES reference values [17], and percent of predicted normal values of FEV1, FVC, and FEV1/FVC ratio were then estimated in accordance with guidelines [16].

A reversibility test was done using 4 puffs of 0.5 mg terbutaline, followed by lung function measurement after 15 min [18]. A significant reversibility was defined as a 12% increase in FEV1 (and minimum 200 mL).