The BASES Expert Statement on Assessment and Management of Non-asthma Related Breathing Problems in Athletes

Produced on behalf of the British Association of Sport and Exercise Sciences by Dr John Dickinson, Prof Alison McConnell FBASES, Dr Emma Ross FBASES, Dr Peter Brown and Dr James Hull.

Introduction

Exercise respiratory symptoms including wheezing, tight chest, difficulty to breathe, shortness of breath, coughing and breathlessness are commonly reported by athletes. These symptoms are non-specific and could be due to a variety of causes outlined in Table 1. It is imperative that clinical assessment and advice is sought initially to either confirm or eliminate the presence of cardio-pulmonary causes. The prevalence of asthma and exercise induced bronchoconstriction (EIB) can be up to 70% in sports with high breathing requirements, and/or sports undertaken in environments where inhaled air is dry and/or polluted. Given this high prevalence, it is tempting to assume that exercise-induced respiratory symptoms in athletes are most likely due to asthma or EIB. However, symptoms alone are misleading; Dickinson *et al*. (2005) reported that 21% of elite British athletes received an inappropriate diagnosis of asthma/EIB. In the majority of these cases, athletes had not undergone an objective airway challenge to confirm diagnosis before therapy was initiated. Current guidelines state that if either asthma or EIB is suspected, an athlete should undergo an airway challenge (e.g., eucapnic voluntary hyperpnoea) to confirm the diagnosis, thus reducing the potential for inappropriate diagnosis (Parsons *et al.*, 2013).

Table 1. Potential causes of exercise induced respiratory symptoms

Asthma	Hyperventilation syndrome
Exercise induced bronchoconstriction	Cardiovascular disease
Lack of fitness	Anaemia
Obesity	Cardiac dysfunction
Exercise induced laryngeal dysfunction	Pneumothorax
Dysfunctional breathing patterns	Parenchymal lung diseases
Anxiety	Pulmonary vascular disorders

It is possible that athletes' respiratory symptoms may not be due to asthma/EIB. Further, athletes with asthma/EIB may still report exercise respiratory symptoms, despite being adequately medicated for their airway disease. The purpose of this BASES expert statement is to provide an overview of the differential diagnosis for exercise-induced respiratory symptoms and to discuss interventions that may help to manage symptoms.

Differential causes of exercise respiratory symptoms

Exercise-induced laryngeal obstruction (EILO)

It is not uncommon to encounter athletes who report troublesome exercise-associated respiratory symptoms in the absence of objective evidence of airway narrowing. It is now recognised that, in a significant proportion of these individuals, symptoms that were attributed to EIB/asthma, may actually arise from a transient exercise-induced narrowing at the level of the larynx (voice box). This phenomenon, termed exercise-induced laryngeal obstruction (EILO), manifests as dyspnoea, wheeze and cough on peak exertion and will not respond to a therapeutic strategy targeting EIB (Nielsen *et al*., 2013). Confirmation of EILO requires direct nasendoscopy to be performed during exercise (see Figure 1), and it should be recognised that there is a considerable overlap between EIB and EILO; i.e., some athletes will have both conditions thus rendering them 'refractory' to EIB treatment alone.

Figure 1. Nasendoscopy diagnostic procedure during exercise

Dysfunction breathing

The term 'dysfunctional breathing' (DB) encapsulates a variety of idiopathic breathing abnormalities that have no obvious organic, pathological origin. DB may be underpinned by abnormal breathing mechanics caused by respiratory muscle dysfunction and/or reduced respiratory system compliance, as well as to anxiety and/or hyperventilation syndrome (see Table 2).

Table 2. Signs and symptoms of dysfunctional breathing during exercise

1	Bias towards chest breathing (rather than diaphragm breathing)
2	Rapid, shallow breathing pattern during exercise, and possibly also at rest (breathing pattern can be regular, or irregular)
3	Inability to synchronise breathing to movement cadence with a consistent rhythm
4	Blunted ventilatory compensation for metabolic acidosis (supra-lactate threshold VE/VO_2 ratio <25 units)
5	Inappropriate ventilatory distress, especially during high intensity exercise

In dysfunctional breathing the primary symptom is breathlessness, resulting in premature exercise intolerance. Physiologically, dysfunctional breathing can result in diametrically opposed signs at rest, compared with exercise. At rest, there may be hyperventilation and hypocapnia, whilst during exercise there may be hypoventilation and hypercapnia. An overreliance upon breathing frequency to meet ventilatory requirements (tachypnoea) leads to an inability to increase minute ventilation (VE) sufficiently to meet metabolic demand. The tachypnoeic breathing pattern, combined with an under-compensated

metabolic acidosis, leads to intense breathing discomfort. Diagnosis of dysfunctional breathing is not straightforward, but an incremental exercise challenge can reveal clear evidence of an abnormal exercise hyperpnoea. Assessment of breathing pattern and respired gases during exercise, as well as observations of breathing at rest and during exercise is therefore recommended.

Interventions for the symptomatic athlete

There is little primary research evidence to support or refute the use of these techniques in the treatment of EILO or DB. Despite this, the standards of care committee support their use in these conditions (Bott *et al*., 2009) and preliminary studies suggest clinical efficacy.

Breathing pattern retraining

Most individuals with EILO and/or dysfunctional breathing have inefficient breathing technique, using chest, or even clavicular breathing, which can increase laryngeal tension. Thus, retraining strategies require a degree of neuromuscular re-education to ensure that the complex inspiratory musculature is used holistically and in concert during both training and everyday life (McConnell, 2011). Thus, breathing pattern training programmes have focused on diaphragmatic breathing and respiratory control. Exercise capacity, breathlessness and quality of life have been improved by breathing training in individuals with EILO and dysfunctional breathing. The athlete, coach and practitioner must be aware of the tendency to fall back into faulty patterns during periods of stress or high ventilatory demand, and develop strategies (such as verbal cues) to adjust breathing during training or competition.

Management of acute severe exercise induced respiratory symptoms

Breathing pattern training can also be used in the management of acute episodes of non-asthma related respiratory distress. Leaning forward to take the weight of the trunk on the knees, or a table, unloads the postural activity of the trunk's respiratory musculature, allowing the respiratory muscles to deliver ventilation. There should also be a focus upon deep, controlled, diaphragmatic breathing, as well as verbal reassurance that the symptoms will subside.

Inspiratory muscle training

Dysfunctional breathing and EILO may only be present during high intensity exercise. The use of inspiratory muscle training (IMT) and breathing pattern retraining have been shown to be effective in resolving respiratory symptoms during high intensity exercise when used holistically. It is important to ensure breathing technique is addressed initially, by focusing upon diaphragmatic breathing, rather than clavicular or chest breathing. Athletes with poor breathing technique, who proceed directly to IMT, may experience exacerbation of their symptoms. Training the inspiratory muscles is performed by breathing forcefully through a hand-held device providing resistance to the inspired airflow. During IMT, the practitioner coaching the athlete should focus upon developing good breathing technique, as well as instructing the athlete to open the 'throat' (larynx and upper airway) fully throughout the inhalation to ensure transferability to exercise conditions. Commercially available pressure threshold devices are considered the most economical tool (time and money) since they target the strength and endurance characteristics of the inspiratory muscles. A typical IMT session comprises 30 continuous forced inspiratory efforts at the equivalent of 30 breath repetition maximum, with relaxed expiration. The use of IMT to attenuate symptoms of dysfunctional breathing and EILO is supported by case studies in Olympic athletes (Dickinson *et al*., 2007).

Conclusions and recommendations

1. Athletes who report exercise-induced respiratory symptoms should have a full patient history and objective airway challenge before assuming a diagnosis of conditions such as asthma and/or EIB.
2. Initial reports suggest that breathing pattern retraining and IMT can be effective interventions to treat exercise-induced respiratory symptoms due to conditions such as EILO and dysfunctional breathing.
3. Understanding the mechanisms of EILO and dysfunctional breathing will allow methods of prevention and treatment for these conditions to be optimised. ■

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Dr James Hull

James is a Consultant Respiratory Physician at the Royal Brompton Hospital, London. He has specialist interest and expertise in asthma, unexplained dyspnoea and respiratory problems in athletes. His main research activity is focused on how the larynx functions during exercise.

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