CASE REPORT

Inspiratory muscle training: a simple cost-effective treatment for inspiratory stridor

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This case study describes the support given to a British elite athlete in the build up to the 2004 Athens Olympic Games. The athlete had complained of breathing symptoms during high intensity training that led to a reduction in performance and premature cessation of training. Following a negative eucapnic voluntary hyperpnoea challenge and observation during high intensity exercise, the athlete was diagnosed with inspiratory stridor. Inspiratory muscle training (IMT) was implemented to attenuate the inspiratory stridor. Following an 11-week IMT programme, the athlete had a 31% increase in mouth inspiratory pressure and a reduction in recovery between high intensity sprints. The athlete reported a precipitous fall in symptoms and was able to complete high intensity training without symptoms. This case shows that IMT is a suitable cost-effective intervention for athletes who present with inspiratory stridor.

In February 2004 a 25-year-old woman of body weight 62 kg and height 177 cm who was ranked number one in the world for her sport presented to the Olympic Medical Institute, Harrow, UK for a eucapnic voluntary hyperpnoea challenge to test for exercise induced asthma (EIA). After a standard pre-challenge questionnaire had been completed and informed consent was obtained, it was established that the athlete had no history of asthma or atopy. On questioning, however, she reported wheezing and dyspnoea during high intensity repeated sprint training in the swimming pool that resolved within 5 min of exercise cessation. There were no symptoms during any land based training. She reported that her sprint training was of poor quality and occasionally had to be abandoned because of her symptoms.

The athlete presented no evidence of EIA following the eucapnic voluntary hyperpnoea challenge (fall in forced expiratory volume in 1 s of 1.7% from baseline). Following consultation with a sports physician and physiologist, the athlete was diagnosed with inspiratory stridor and an inspiratory muscle training (IMT) intervention was implemented.

The IMT intervention required 30 loaded breaths twice daily using a Powerbreathe inspiratory muscle trainer (Gaiam Ltd, Southam, UK) five times per week for 11 weeks. The intensity of each breath was 50–60% of maximal inspiratory mouth pressure (a surrogate of inspiratory muscle strength).[1] She was instructed to inhale using her diaphragm and to minimise cranial shoulder movements during the IMT to promote correct breathing technique.

Pre- and post-IMT assessments were devised to monitor changes in lung function, inspiratory muscle strength, symptoms and performance. The athlete undertook 15×50 m sprints in the swimming pool with a maximum rest of 30 s between each sprint and was instructed to keep the rest to a self-selected minimum.[1] Between sprints the athlete rated perceived breathing discomfort (Borg CR10). In addition, observations of breathing pattern and noise were made. Maximal inspiratory pressure and maximal flow-volume loops were measured before and 5 min after the sprint test. The athlete was tested again after 11 weeks of IMT intervention.

There was no evidence of EIA following either the pre-IMT or post-IMT repeated sprint tests. Post-IMT, maximal inspiratory pressure improved from 144 cm H_2O to 188 cm H_2O (31%). There was no evidence of a reduction in maximal inspiratory pressure following the repeated sprint challenge before or after the IMT intervention. The average sprint time did not change after IMT (35.1 s vs 35.9 s); in contrast, the average rest time between sprints was reduced from 16.0 s before IMT to 12.1 s after IMT.

Before IMT inspiratory stridor was observed after every sprint from sprint 6 to sprint 15, but only occurred once following sprint 9 after IMT. The mean rating of breathing discomfort was 6.6 before IMT and 6.0 after IMT and was consistently lower throughout the post-IMT test.

Subjectively, the athlete reported feeling more confident during high intensity swimming sessions and her inspiratory symptoms were barely noticeable after IMT. The improvement in her breathing resulted in her being able to complete high intensity training. The athlete went on to compete at the 2004 summer Olympic Games winning a bronze medal.

DISCUSSION

Inspiratory stridor is a condition characterised by high pitched inspiratory noise that is often mistaken for the wheeze of asthma.[2–4] The presence of inspiratory stridor is associated with vocal cord dysfunction that can be diagnosed by laryngoscopy. This is very invasive, however, and the patient must have symptoms, which is problematic if inspiratory stridor is only induced by high intensity exercise. Symptom based diagnosis is therefore a more common and practical method (table 1). The prevalence of inspiratory stridor is unknown, but it has been estimated at 2–3% of the general population with most cases

Table 1 Differences between the characteristics of exercise induced asthma and inspiratory stridor

Exercise induced asthma	Inspiratory stridor
Occurs 5–10 min after exercise	Occurs during exercise and resolves within 5 min of stopping exercise
Wheeze on expiration	Wheeze on inspiration
Fall in FEV_1 after exercise	No fall in FEV_1 after exercise
Sound is primarily from the chest	Sound originates in the neck
Responds to inhaled β_2 agonist treatment	No response to inhaled β_2 agonist treatment

FEV_1, forced expiratory volume in 1 s.

Abbreviations: EIA, exercise induced asthma; IMT, inspiratory muscle training

What is already known on this topic

- Approximately 20% of British elite athletes present with exercise induced asthma (EIA).
- Many athletes with symptoms of EIA also present with EIA on bronchoprovocation testing.
- 5% of athletes present with inspiratory stridor.
- 50% of athletes with inspiratory stridor also present with EIA.

What this study adds

Inspiratory muscle training is a suitable cost-effective intervention for athletes who present with inspiratory stridor.

being adolescent females.[5 6] The prevalence in elite athletes has been reported to be 5%; 53% of these cases also present with EIA.[7]

Recent evidence supports the role of IMT in the treatment of inspiratory stridor associated with its role in activating muscles of the upper airway.[8] Two previous case studies have reported successful implementation of IMT to restore normal vocal fold function in junior and subelite competitors.[9 10] To date, limited data exist in elite athletic populations.

The objective of this intervention was to enable the athlete to complete high intensity training sessions in the swimming pool, which was achieved. The assessments that were conducted before and after IMT confirmed that IMT improved maximal inspiratory pressure, induced an improved rate of recovery between sprints and reduced breathing discomfort. In addition, the onset of inspiratory stridor was delayed and the athlete's perception of limitations induced by her breathing was much improved. These data are consistent with previous case studies of IMT and inspiratory stridor in junior and subelite athletes,[9 10] confirming the usefulness of IMT as a treatment for inspiratory stridor in world class athletes.

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Competing interests: Alison McConnell has a beneficial interest in the Powerbreathe Inspiratory Muscle Trainer in the form of a royalty share on licence income to the University of Birmingham, UK. She also acts as a consultant to Gaiam Ltd.

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COMMENTARY

Awareness of the occurrence of inspiratory stridor in athletes is increasing in the sports medicine community, saving a considerable amount of time and expense. Previous recommendations for the management of this condition have been somewhat vague. This paper adds to the weight of evidence that a relatively simple intervention may be effective.

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