

Efficacy of Inhaled Corticosteroids in Treatment of Exercise-Induced Bronchoconstriction in Adolescent Swimmers



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Abstract

Exercise-induced bronchoconstriction (EIB) is a pulmonary disorder mostly associated with athletes that causes acute airway narrowing during exercise. The treatment of choice is a short-acting beta agonist such as albuterol to assist with airway dilation, but this treatment has been inefficient in athletes who are exposed to inhaled irritants such as swimmers. The swimming world fears that repetitive albuterol use can give athletes a boost due to its side effects. Therefore, this review examines the use of inhaled corticosteroids (I) for management of symptoms such as wheezing and shortness of breath (O) in adolescent swimmers diagnosed with EIB (P) compared to the treatment of choice (C).

Introduction

- Exercise-induced bronchoconstriction (EIB) is a disorder related to athletes caused by the loss of heat and/or water from the airways during exercise from rapidly inhaled air that is drier than that of normal body air
- The general population diagnosed with EIB is approx. 5-20%, varying based on geographical location¹
 - Higher in locations where the air is dry, cold, and contains airway pollutants¹
 - Can be brought on by sports-related irritants, such as chlorine in swimmers or pollen from grasses on soccer fields
- Short acting beta-agonists (SABAs) such as Albuterol are currently considered the treatment of choice for intermittent asthma symptoms resembling EIB according to the American Thoracic Society²
 - Inhaled corticosteroids such as fluticasone and beclomethasone are used as maintenance therapy for athletes whose EIB is not well controlled with a SABA.
- Recently the swimming community has noticed that swimmers are taking multiple doses of the Albuterol inhalers due to failure of the treatment.
 - Their sympathetic nervous system-inducing side effects could potentially give the swimmers an advantage in the pool.
- Inhaled corticosteroids may be able to help with the swimmer's EIB symptoms while also eliminating the "unfair advantage" a beta-2-agonist may provide.

Methods

Literature Search

- Performed in November 2018 using:
 - PubMed
 - Google Scholar
- Inclusion Criteria
 - Published in peer-reviewed journal
 - Published within the last 5 years
 - Based upon case study, randomized control trial or cross sectional study
- Exclusion Criteria
 - Investigated other allergy symptoms such as eczema, psoriasis or cough
 - Allergies to substances other than chlorine or swim-related substances
 - Solutions to bronchoconstriction other than corticosteroids or beta-2-agonist inhalers
 - Treatments for conditions other than exercise-induced bronchoconstriction
 - Outside patient population of adolescent swimmers
 - Meta-analyses or systematic reviews
 - Patents or citations

Results

- Cavaleiro Rufo J, Paciência I, Silva D, et al. Swimming pool exposure is associated with autonomic changes and increased airway reactivity to a beta-2 agonist in school aged children: A cross-sectional survey. PLoS One. 2018;13(3):e0193848. Published 2018 Mar 12. doi:10.1371/journal.pone.0193848**
- Cross-sectional study of 858 participants performed in order to examine the effects of long-term swimming pool attendance on lung and autonomic function of 7-12-year-old children and examine how a beta-2-agonist will improve lung function
- Hoshino Y, Koya T, Kagamu H, et al. Effect of inhaled corticosteroids on bronchial asthma in Japanese athletes. Allergy International, 2015;64(2):145-149.**
- Cohort study of 80 athletes performed in order to determine the efficacy of inhaled corticosteroids and montelukast in athletes with EIB in differing types of training environments.
- Romberg K, Tufvesson E, Bjermer L. Asthma symptoms, mannitol reactivity and exercise-induced bronchoconstriction in adolescent swimmers versus tennis players. J Asthma Allergy. 2017;10:249-260. Published 2017 Oct 3. doi:10.2147/JAA.S134794**
- Cross-sectional study of 187 participants performed in order to determine the prevalence of asthma and allergy as well as comparing the two types of athletes to determine if a swimming pool is considered an unfavorable athletic environment.
- Sastre B, Fernandez-Nieto M, Rodriguez-Nieto MJ, et al. Distinctive bronchial inflammation status in athletes: basophils, a new player. Eur J Appl Physiol. 2013;113:703-11.**
- Case-control study of 68 participants performed to gain a cellular profile on the epithelial lung tissue and compare between athletes and non-athletes to determine if their exercise environment can change their cellular components
- Schafroth Török S, Mueller T, Miedinger D, et al. An open-label study examining the effect of pharmacological treatment on mannitol- and exercise-induced airway hyperresponsiveness in asthmatic children and adolescents with exercise-induced bronchoconstriction. BMC Pediatr. 2014;14:196. Published 2014 Aug 2. doi:10.1186/1471-2431-14-196**
- Randomized control trial of 14 participants designed to examine whether the mannitol challenge test was a better diagnostic study for exercise-induced bronchoconstriction rather than the standard methacholine challenge testing.
- Simpson AJ, Romer LM, Kippelen P. Self-reported Symptoms after Induced and Inhibited Bronchoconstriction in Athletes. Med Sci Sports Exerc. 2015;47(10):2005-13.**
- Randomized control trial of 45 participants designed to test the correlation between subjective ratings of symptoms versus objective changes in airway caliber. Additionally, those performing this study wanted to determine if they could distinguish those with EIB from those without EIB.

Table 1. Comparison of Study Designs for Inhaled Corticosteroid vs. Beta-2-Agonist

Study	Design	Total N	Age Range (Years)	Duration of Intervention	Dosing Frequency	Outcome measurements
Cavaleiro et al. (2018)	CSS	858	7-12	14 months	400 mcg salbutamol inhaled	FEV ₁ , MCV, ACV, exhaled NO, eosinophilic airway inflammation, allergic sensitization, pupillometry
Hoshino et al. (2015)	Cohort	80	15-17	12-24 weeks	ICS: Budesonide 800 mcg daily (≥15 y/o) B2A: salbutamol inh 200 mcg	FEV ₁ , exhaled NO, IgE, atopy
Romberg et al. (2017)	CSS	187	13-20	2 days with one week between each day	Terbutaline 1 mg inh	FEV ₁ , FVC, Atopy questionnaire, exhaled NO, trichloramine air content
Sastre et al. (2013)	Case control	68	13-61	1 week with three separate visits	Terbutaline 500 mcg inhaled	FEV ₁ , FVC, exhaled NO, atopy, basophil count in sputum
Schafroth et al. (2014)	RCT	14	9-20	21 days	Budesonide 400 mcg inhaled Montelukast 10 mg inh daily	FEV ₁ , FVC, ECT, MCT
Simpson et al. (2015)	RCT	45	18-55	1 week with three separate visits	Terbutaline 500 mcg inhaled	Max fall in FEV ₁ , cough, wheeze, chest tightness, mucus secretion

Discussion

Overall, both treatments (inhaled corticosteroids (ICS) and short-acting beta agonists (SABA)) improved patient's symptoms of exercise-induced bronchoconstriction. Though only 1/3 studies compared side-by-side the efficacy of inhaled corticosteroids vs. short-acting beta-agonists in athletes. Therefore, it will be difficult to determine whether one treatment is superior to the other for such populations.

- Strengths
 - Length of study
 - Lack of bias
 - Data analysis
 - Subject age
- Limitations
 - Study sample sizes
 - Blinding
- Future research
 - Using components of each of these studies to ultimately determine if ICS is a better treatment for swim athlete's EIB symptoms
 - Genetic response to ICS treatment
 - Follow-up study determining the long-term effects of ICS treatment



Conclusion

Although the evidence is strong for the benefits of ICS use in swimmers, there are factors that these studies did not consider

- Long-term impact of ICS on swim athletes
- Genetic consideration

Given the evidence from the studies analyzed, it is determined that swim athletes would likely benefit from the use of inhaled corticosteroids daily to help with long term care of their EIB

An inhaled corticosteroid plus or minus montelukast will be best used as a daily treatment regardless of whether an athlete would be performing an activity or not, and potentially use a beta-2-agonist or other treatment in acute situations, or active asthma exacerbation.

Inhaled corticosteroids do not produce as many side effects as systemic corticosteroids, so there is low risk for harm in populations with sensitivities to these types of medications.

References:

- Aggarwal B, Mulgirigama A, Berend N. Exercise-induced bronchoconstriction: prevalence, pathophysiology, patient impact, diagnosis and management. *NPI Prim Care Respir Med.* 2018;28(1):31. Published 2018 Aug 14. doi:10.1038/s41533-018-0098-2
- Caggiano S, Cutrera R, Di Marco A, Turchetta A. Exercise-Induced Bronchospasm and Allergy. *Front Pediatr.* 2017;5:131. Published 2017 Jun 8. doi:10.3389/fped.2017.00131