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Aerobic exercise increases BKCa channel expression to enhance tracheal smooth muscle relaxation in a murine asthma model

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Objective Increasing evidence has shown that moderate-intensity aerobic exercise training reduces airway hyperresponsiveness (AHR) in patients with asthma. However, the mechanisms underlying exercise-induced improvements in smooth muscle contractility have not been fully elucidated. Large-conductance Ca^{2+} -activated K^+ channels (BK_{Ca}) are expressed broadly on smooth muscle cells and play an important role in the regulation of smooth muscle contraction. We tested the hypothesis that exercise training increases the contribution of BK_{Ca} channel to tracheal smooth muscle relaxation in ovalbumin (OVA)-challenged asthmatic rats.

Methods Rats were sensitized/challenged with OVA or saline and exercised at a moderate intensity 5 times/week for 4 weeks. Tracheal smooth muscle contractility was tested. Membrane potential of primary cultured tracheal smooth muscle cells was measured. In addition, western immunoblotting was performed to study the expression levels of BK_{Ca} channel protein.

Results The contraction of rat airway smooth muscle induced by carbachol was significantly increased with asthma and exercise training reversed this alteration. Application of BK_{Ca} channel agonist, NS1619, induced tracheal smooth muscle relaxation. NS1619-induced relaxation was decreased in asthmatic rats, however exercise training significantly increased NS1619-induced relaxation. In primary cultured smooth muscle cells, NS1619-induced membrane potential was reduced with asthma and this alteration was diminished after exercise training. Additionally, western blotting revealed that the protein expression of BK_{Ca} was reduced in asthmatic group and aerobic exercise significantly improved BK_{Ca} expression.

Conclusions The present study reveals that aerobic exercise training increases BK_{Ca} expression on tracheal smooth muscle, which partly underlies the beneficial effect of exercise on improving airway smooth muscle relaxation in asthma.