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Asthma and Obesity- The Recent Advancements

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Abstract

The incidence of obesity and asthma is increasing globally. Evidence shows that there is a correlation between the two, both epidemiologically and pathophysiologically. The inflammatory link between the two is now being established as obesity is a risk factor for asthma and also plays an important role in its prevention and management. Evidence shows that patients with metabolic disorders such as insulin resistance may be at an increased risk for asthma, however the exact pathophysiology of the same remains unknown. We hereby present an overview of the recent advancement in this field.

Keywords: Asthma, Inflammation, Obesity

1. Introduction

Asthma is characterized by airway inflammation, shortness of breath, coughing, and wheezing. Though airway obstruction is the hallmark of asthma, other causes may include obesity, stress, and obstructive sleep apnea[1]. An increasing prevalence of asthma worldwide, across ages and genders is worrying with more than 300 million people affected[2]. Importantly, there is an overlap between epidemiology of obesity and asthma[3].

The prevalence of obesity is increasing, and evidence shows that this may have an adverse effect on lung functions[4]. The collated data from three National Health and Nutrition Examination Surveys indicated that up to about 33% of obese patients had asthma[5]. Another study also showed a relationship between obesity and asthma[6].

2. Obesity and Asthma

Obesity, especially the central obesity compresses the chest along with flattening of the diaphragm. This may reduce the tidal volume by directly impacting the lung expansion and the Functional Residual Capacity (FRC), and hence increase airway hyper-responsiveness[7]. As expected an increasing weight, and hence an increasing BMI may reduce the FRC of the lung[8]. As a result, obese patients with asthma may present with a reduced operating lung volume[9].

Obesity is a state of inflammation, and evidence shows that several inflammatory mediators are active in obese and overweight subjects. Similarly, evidence also shows that asthma too is associated with active inflammation, and trigger asthma attacks. There is a link between

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the severity of obesity and asthma, and there may be a worsening in the severity of the disease with increasing BMI[10].

3. Insulin Resistance and Asthma

Insulin resistance is an innate feature of obesity, and shown to impact the lung functional capacity, forced expiratory volume in 1 second (FEV1), the forced vital capacity, as well as their ratio, the Tiffeneau-Pinelli index[11]. This clearly suggests that obesity has a direct impact on lung function, and is associated with pathophysiology of asthma. Nonetheless, it also appears that insulin resistance may induce structural changes in the lungs besides driving the inflammatory invasion in lungs[12,13]. Such changes are also known to be associated with metabolic syndrome[14].

4. Inflammatory Link Between Obesity and Asthma

A number of cellular signaling and metabolism mechanisms could contribute to increased asthma risk in obese and overweight patients. One of these is inflammation. Allergic asthma is known to be associated with inflammation, and increase in cytokine levels, e.g. IL-4 and IL-5 responsible for promoting airway eosinophilia, and IL-13 that causes hypersecretion of mucus. On the other hand, there could be inflammatory cascade that may cause remodeling of the lung airways[15,16].

Inflammtory cytokines that play a key role in obesity[17], and may have a role in allergic asthma as well[18]. Increased levels of serum leptin have been shown to be associated with asthma in obesity, and related to airway reactivity[19,20]. The deficiency of leptin may also be associated with a reduced lung volume and lesser availability of alveolar surface to facilitate gas exchange[21]. Importantly, an increased expression of leptin and adiponectin in lungs and adipose tissue of obese patients with asthma has been reported, and there was a significant correlation between leptin and airway hyper-responsiveness[22]. Such a relationship has been noted in children as well[23].

Leptin and adiponectin are adipocytokines with has proinflammatory activities, and have been implicated in pathophysiology of bronchial asthma[24,25]. A direct correlation between leptin, lung dysfunction and airway hyper-responsiveness has been observed in obese or overweight patients with asthma[26,27,28]. However, it should be noted that high levels of leptin while low levels of adiponectin are associated with obesity, and probably asthma. In a long-term follow up study, BMI strongly predicted asthma[29]. Other inflammatory cytokines that modulate and have an effect on signs and symptoms of asthma include IL-6 and TNF-alpha[30].

Asthma is characterized by the presence of an inflammatory cells in bronchial mucosa that include activated mast cells, eosinophils, and T-lymphocytes. Cytokines namely IL-4, IL-5, IL-6, and TNF-alpha are known to play an important role in asthma, which are also associated with obesity, which is again a state of inflammation[30]. TNF-alpha is known to be elevated in uncontrolled, severe asthma, stimulating the production of IL-4 and IL-5 and recruitment of inflammatory cells in bronchial mucosa, and may be a key link between asthma and obesity.

5. Obesity and Asthma Management

Evidence shows that patients with higher BMI have more early morning symptoms, greater compromise in daily activities, more shortness of breath and wheezing, and an increased need for rescue medication. Higher BMI also led to lower scores on the Asthma Quality of Life Questionnaire[31]. Other studies also study showed that normal-weight had a better asthma control versus obese and overweight patients[32,33].

Similarly, the drug response to asthma medications also vary by the BMI. Evidence shows that obesity may influence the efficacy of asthma treatments, and weight loss may enhance the efficacy of the treatment. The data from a recent study showed that the anthropometric obesity measures correlated with a poor efficacy and poor quality of life and life in obese patients with asthma[34,35], and increased the risk of hospitalizations[36].

Overall, the data clearly supports the link between obesity and asthma, and obese and overweight patients have a difficulty in being treated due to reduced efficacy of the treatment(s), and their symptoms are exacerbated by a coexisting obesity[37,38]. Therefore, weight loss in these patients with asthma and obesity may not only lead to the improvements in asthma control, but also improve the response to medications, and overall asthma-related quality of life.

6. Conclusion

Growing evidence suggests that asthma is linked to obesity, in severity as well as its prevention and management. Weight management in overweight patients may therefore help in management and prevention of asthma in obese and overweight patients.

7. References

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