Effect of MUC5AC and MUC5B mucins on airway clearance by simulated cough

Roger Yu

Introduction

The airways are lined with epithelial cells that produce mucus layers which protect the body from pathogens inhaled from the air every day. This critical layer bind/trap these pathogens and then clear them out of the respiratory system. Without a proper way to clear the mucus in these areas, the airways can become obstructed leading to trouble breathing.

Understanding quantitatively how thicker mucus clear differently by cough is critical to helping treat people with upper respiratory disease. The best-known phenotype that correlates with seemingly unrelated airway diseases, such as COPD, Asthma, and cystic fibrosis (CF), is the accumulation of thick, “sticky” mucus in the airways. Previous literature has shown1 that proper hydration of both mucus and periciliary layer (PCL) is required for efficient mucus clearance and that accumulation of thick, “sticky” mucus in the airways is not yet confirmed why the body produces seemingly unrelated airway diseases, such as COPD, Asthma, and cystic fibrosis (CF), is the hypothesized that different airway diseases, such as chronic bronchitis and asthma, have different hydration of both mucus and periciliary layer (PCL) is required for efficient mucus clearance and that accumulation of thick, “sticky” mucus in the airways. Previous literature has shown1 that proper hydration of both mucus and periciliary layer (PCL) is required for efficient mucus clearance and that accumulation of thick, “sticky” mucus in the airways.

Methodology

Cough Clearance of MUC5AC and MUC5B at varying concentrations. In this work, to simulate a cough, a vacuum was used to pull air across the surface of the cell culture in one direction. Then, a series of images (at 10 fps) of the cough during the airflow were captured, and the relative amount of the beads moving backward. The length of the cough train (for 30 seconds) and a mean ± standard deviation (SD) of 158 ± 150 mm/s was recorded to obtain the recovery of the mucus post-cough.

Data analysis: The objective of these studies was to understand whether the relative ratios of MUC5AC to MUC5B affect cough mediated mucus transport system. These studies were performed by varying mucin concentration (ranging from normal 2% to CF 10%) and examining the mucus concentration and mucus accumulation speeds of both genotypes.

In this study the important conclusion is that the MUC5AC mucus caused a slower cough clearance speed consistently at different mucin concentrations compared to the MUC5B mucin.

Discussion

In this study the important conclusion is that the MUC5AC mucus caused a slower cough clearance speed consistently at different mucin concentrations compared to the MUC5B mucin. Figure 1 showed that both 2% and 6% of mucin was there was a clear trend that MUC5AC had a significantly slower clearance speed than MUC5B. This is consistent with the hypothesis that MUC5AC is a "stickier" mucin that while making it more sticky to inhaled pathogens, result in it being harder to clear mucins from the lungs. In chronic mucin-overproduction diseases, such as asthma, COPD, and CF, the increase in mucin concentration and mucins production, combines to make it extremely difficult for affected individuals to clear their mucous properly.

Another effect that was observed was confirming that increasing mucin concentration led to lower cough clearance speeds. The effects of different types of mucins (MUC5AC and MUC5B) on the clearance of cough were observed to quantify how these different types of mucins affected cough clearance speeds. It was determined that as one increased the mucin concentration on the cell culture, there was a decrease in the speed of the cough clearance, likely due to more friction and adhesion properties of the mucus cluing to the layer of cells underneath it. In these studies, as seen in Figure 2, it can be seen that for normal and mucin (2%) and sickly mucins (6%) that MUC5AC is harder to clear because of its significantly lower velocities that were recorded in cough simulations. However, for 10% mucin, the differences between MUC5AC and MUC5B have been negligible likely due to increased friction/adhesion dominating any MUC5B/MUC5AC isofor difference.

These interactions will be further researched in the future research in future semen led to lower cough clearance speeds. The effects of different types of mucins (MUC5AC and MUC5B) on the clearance of cough were observed to quantify how these different types of mucins affected cough clearance speeds. It was determined that as one increased the mucin concentration on the cell culture, there was a decrease in the speed of the cough clearance, likely due to more friction and adhesion properties of the mucus cluing to the layer of cells underneath it. In these studies, as seen in Figure 2, it can be seen that for normal and mucin (2%) and sickly mucins (6%) that MUC5AC is harder to clear because of its significantly lower velocities that were recorded in cough simulations. However, for 10% mucin, the differences between MUC5AC and MUC5B have been negligible likely due to increased friction/adhesion dominating any MUC5B/MUC5AC isofor difference.

References