Does CT Mucus Burden Differ in Moderate as Compared to Severe Asthma?

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Introduction

- Airway mucus plugs and occlusions common in severe asthma
- Chest computed tomography (CT) provides effort-independent and non-invasive method to visualize and quantify airway mucus plugs
- Mucus plugs recently classified as short and "stubby" or long and "stringy"[1]
- In severe asthma and chronic obstructive pulmonary disease, CT mucus plugs relate to airflow obstruction, quality-of-life, and disease severity[2-4]
- The prevalence of CT mucus plugs in people without chronic or severe obstructive lung disease is poorly understood, as is deeper understanding of their clinical relevance
- A deep understanding of the disposition and prevalence of airway mucus and its relationship with airway function needed

Objective

Evaluate and compare airway mucus occlusions in healthy participants and patients with GINA 4 and GINA 5 asthma

Methods

- Healthy participants without chronic lung disease (n=42) evaluated (NCT02483403)
- Participants with GINA 4 (n=26) and GINA 5 (n=32) asthma evaluated (NCT03733535, NCT04651777)
- All participants provided written informed consent to thoracic CT imaging and spirometry
- CT mucus-count quantified as total number of CT visible mucus-plugs[5,6]
- CT mucus-score quantified as total number of bronchopulmonary segments out of 20 with at least one CT mucus plug[2]
- Differences between groups evaluated using analysis of variance (ANOVA)
- Univariate relationships evaluated using Spearman (ρ) correlations

Results

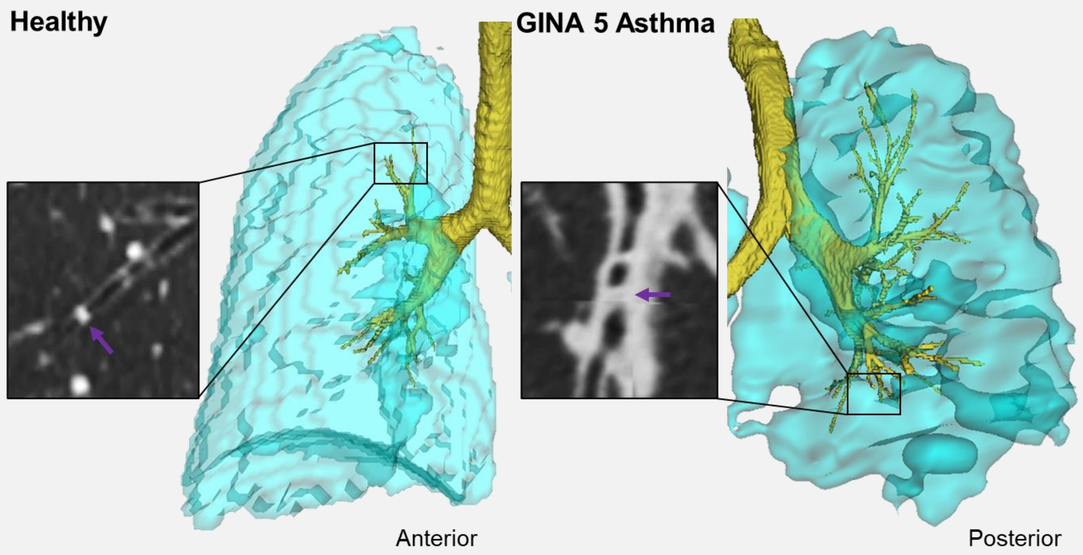

Figure 1. Airway mucus in healthy and GINA 5 asthma. CT airway tree (yellow) co-registered with ^{129}Xe MRI ventilation (cyan) with CT image insets showing airway mucus plugs. Healthy participant is a 68-year-old female with mucus score=1 and mucus count=1, which is the upper limit of normal. GINA 5 asthma participant is 62-year-old male with mucus score=9 and mucus count=13. Mucus plug in GINA 5 participant is spatially related to MRI ventilation defect.

Table 1. Participant Demographics, CT Mucus and Pulmonary Function Measurements

Parameter mean±SD	Healthy (n=42)	GINA 4 (n=26)	GINA 5 (n=32)	ANOVA *P*
Age years	74 ± 6	54 ± 15	59 ± 13	<.001
Female n %	21 (50)	19 (73)	23 (72)	.07
BMI kg/m^2	26 ± 4	30 ± 7	30 ± 5	.004
With Mucus n (%)	18 (43)	19 (73)	21 (66)	.03
Mucus Count n	1 ± 2	6 ± 10	5 ± 8	.01
Mucus Score n	1 ± 2	3 ± 4	3 ± 4	.002
FeNO ppb	-	37 ± 41	44 ± 34	.5
FEV_1 $\%_{pred}$	107 ± 18	72 ± 19	63 ± 19	<.001
FVC $\%_{pred}$	103 ± 15	87 ± 12	79 ± 16	<.001
FEV_1/FVC %	77 ± 6	66 ± 12	63 ± 12	<.001

P=ANOVA for differences between healthy, GINA 4, and GINA 5 participants; CT=computed tomography; BMI=body mass index; FeNO=fractional exhaled nitric oxide; FEV_1=forced expiratory volume in one second; FVC=forced vital capacity.

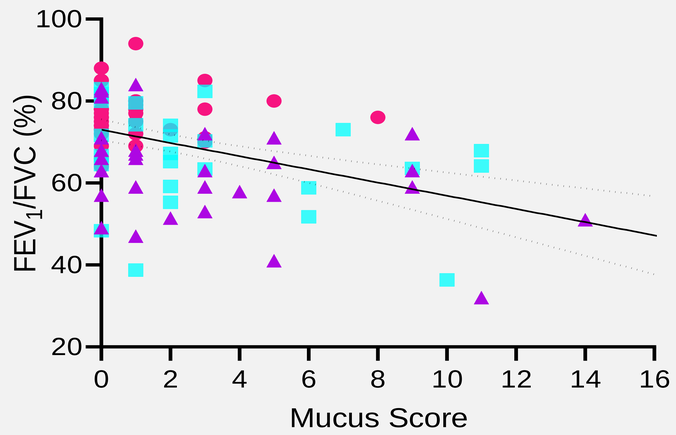

Figure 1. Linear relationships for mucus score and FEV_1/FVC
Significant correlation for CT mucus score with FEV_1/FVC for all participants (ρ=-.385, *P*<.001) and GINA 5 asthma (ρ=-.377, *P*=.04) but not healthy participants (ρ=-.106, *P*=.5) or GINA 4 asthma (ρ=-.305, *P*=.1).

Discussion

- Greater airway mucus burden in moderate (GINA 4) asthma compared to healthy participants
- No significant difference in mucus burden between GINA 4 and GINA 5 asthma
- Downstream ventilation consequences to airway mucus in asthma as compared to healthy participants (Figure 1)
- Mucus plugs in healthy participants "stubby" as compared to more "stringy" plugs in asthma participants
- Correlation of mucus score with FEV_1/FVC driven by GINA 5 asthma participants (Figure 2)
- Increasing evidence of mucus occlusions contributing to airflow obstruction in asthma[2]
- Mucus count and mucus score greater than upper limit of normal of one plug in GINA 4 and GINA 5[7]
- Mucus plugs may be considered as a treatable trait in moderate and severe asthma

Conclusion

Patients with GINA 4 and GINA 5 asthma have similar airway mucus plug burden which may serve as a target for therapy

References

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