**Background**

Mucus is a barrier to airway water loss and microbial invasion and maintains homeostasis in the airway. In patients with cystic fibrosis (CF), the sputum is tenacious, leading to abnormal mucus clearance. We have conducted a longitudinal study to examine changes in the biophysical properties of CF sputum over time in relation to disease status.

**Objectives**

1. To evaluate if changes in viscoelastic properties of CF sputum correlate with changes in pulmonary function over time
2. To evaluate if viscoelastic properties of CF sputum change with therapy

**Methods**

**Sputum:**

CF sputa were collected from 8 subjects (4 male; 6 adolescents, 2 adults) during pulmonary function testing at each clinical encounter over 5 years. Sputa were frozen at -80°C until analyzed.

**Dynamic rheology:**

Dynamic rheology was measured using an AR1500ex rheometer (TA Instruments) in oscillatory mode over the linear portion of the stress/strain curve from 0.1 to 10 rad/s. The elastic G’ and viscous moduli G’’ are given in Pa·sec.

**Pulmonary function testing (PFT):**

PFT was performed during outpatient clinic visits and met ATS criteria for reproducibility and expiratory time. The results are reported using NHANES III reference values.

**Table 1:** Clinical and demographic characteristics of CF subjects (n=8).

<table>
<thead>
<tr>
<th>Age (yr)</th>
<th>Sex</th>
<th>Sputum Pathogen(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
<td>M</td>
<td>MR. S. aureus, P. aeruginosa</td>
</tr>
<tr>
<td>15</td>
<td>F</td>
<td>P. aeruginosa, A. fumigatus</td>
</tr>
<tr>
<td>15</td>
<td>M</td>
<td>NS S. aureus</td>
</tr>
<tr>
<td>14</td>
<td>M</td>
<td>MR. S. aureus, A. fumigatus</td>
</tr>
<tr>
<td>52</td>
<td>F</td>
<td>P. aeruginosa</td>
</tr>
<tr>
<td>34</td>
<td>M</td>
<td>P. aeruginosa</td>
</tr>
<tr>
<td>13</td>
<td>F</td>
<td>MR. S. aureus, P. aeruginosa, A. fumigatus</td>
</tr>
<tr>
<td>12</td>
<td>F</td>
<td>MR. S. aureus</td>
</tr>
</tbody>
</table>

**Discussion**

The changes in viscoelastic properties correlate with changes in lung function as demonstrated by FEV1 %Predicted and the slope of this correlation was similar for all subjects.

During an exacerbation of CF lung disease requiring antibiotic therapy there is decreased FEV1 while G’ and G’’ both increase. As FEV1 returns to baseline after therapy both G’ and G’’ return to pre-exacerbation values.

**Conclusions**

The viscoelastic properties of CF sputum change in response to disease severity.

We speculate that changes in viscoelastic properties of CF sputum are due to changes in mucin and DNA polymer structure during the course of illness.

Sputum rheology may serve as a biomarker for CF disease surveillance and response to therapy.

**References**