Is the FRC/TLC Ratio a valid measure in children with obstructive lung disease

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Introduction:
Hyperinflation is present in some patients with obstructive lung disease in an attempt to reduce early airway closure and augment lung elastic recoil. Presence of static hyperinflation can be determined physiologically. The ERS/ATS guidelines (1) state that you should use the ratio between residual volume and total lung capacity (RV/TLC %). However, a raised functional residual capacity (FRC) defines the presence of hyperinflated lungs.

We aimed, therefore, to determine whether the FRC/TLC\%, in addition to the RV/TLC\%, was elevated in children with obstructive lung disease and whether this was greater in those with greater severity of obstructive lung disease.

Methods:
A retrospective analysis was conducted of data collected over the last 5 years. Children aged 4-18 years were graded into no airway obstruction, mild, moderate and severe obstruction. Normal was defined as an FEV1/FVC% > -1.64 Z scores. ARTP recommendations were used to determine the presence of obstructive lung disease and for severity classification.

Correlations were run on all the parameters against the corresponding FEV1 Z scores. ROC curves were also applied to the data. Sensitivity and specificity measurements were calculated. These were separated into two groups. One with no or just mild airflow obstruction – who were not expected to have hyperinflation and one with moderate and severe airflow obstruction – who would be expected to have hyperinflation.

Results:
3\% of children in the normal/mild obstructive group demonstrated abnormal FRC/TLC\% versus 38\% in the moderate/severe group.

32\% of children in the normal/mild obstructive group demonstrated abnormal FRC/TLC\% versus 92\% in the moderate/severe group.

<table>
<thead>
<tr>
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<th>FRC/TLC</th>
<th>RV/TLC</th>
<th>FRC Z score</th>
<th>TLC Z score</th>
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</thead>
<tbody>
<tr>
<td>Correlation with FEV1 Z score</td>
<td>-0.46</td>
<td>-0.6</td>
<td>-0.24</td>
<td>-0.039</td>
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<tr>
<td>Area under ROC Curve (95% CI’s)</td>
<td>0.857 (0.834 - 0.878)</td>
<td>0.879 (0.858 - 0.899)</td>
<td>0.809 (0.784 - 0.833)</td>
<td>0.63 (0.60 - 0.660)</td>
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<tr>
<td>Sensitivity (95% CI’s)</td>
<td>88.54 (80.4 - 94.1)</td>
<td>91.67 (84.2 - 96.3)</td>
<td>65.62 (55.2 - 75.0)</td>
<td>42.11 (32.0 - 52.7)</td>
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<tr>
<td>Specificity (95% CI’s)</td>
<td>66.95 (63.8 - 70.0)</td>
<td>67.59 (64.5 - 70.6)</td>
<td>88.63 (86.4 - 90.6)</td>
<td>83.0 (80.4 - 85.3)</td>
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</table>
Conclusions

The FRC/TLC% is elevated in children with obstructive lung disease, with the instance of elevation increasing with increasing severity of obstructive lung disease. RV/TLC% is also increased, but to a greater extent, in children with obstructive lung disease and follows the same pattern with increasing severity of lung disease.

Therefore we postulate that this relationship suggests gas trapping, as defined as an elevated RV/TLC%, is more prevalent at an earlier stage in paediatric obstructive lung disease than hyperinflation, as defined as an increase in FRC/TLC%.

Further research is required to determine the definitive relationship between FRC/TLC% and hyperinflation in this paediatric population.

References