Fluoroscopic Determination of Thoracic Dimensional Changes in Healthy Dogs
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Introduction

- Interstitial lung diseases (ILDs) reduce compliance, which is defined as the ability of pulmonary parenchyma to change volume under a given pressure.\(^1\)
- Diagnosing ILDs relies on high-risk lung biopsies or complex determination of pulmonary mechanics.\(^2,3\)
- The aim of this prospective study was to determine if pulmonary fluoroscopy can noninvasively quantify the percent change in thoracic dimension during tidal respiration to yield a repeatable reference range.
- This range would ultimately be used for comparison to dogs with respiratory disease as a surrogate for pulmonary compliance.

Methods

- 44 healthy dogs positioned in sternal recumbency were fluoroscopically imaged for 10 respiratory cycles during tidal respiration.
- Maximal inspiratory and expiratory images were captured from 3 respiratory cycles in each dog.
- Pixel counts were measured as an estimate of lung area for the entire thorax (‘Total’; Fig. 1A) and excluding the mediastinum and heart (‘Segmented’; Fig. 1B).
- Percent change in thoracic area was calculated as:
  \[ \text{Percent change} = \frac{\text{pixels inspiration} - \text{pixels expiration}}{\text{pixels inspiration}} \times 100 \]
- For large dogs whose thoracic cavity did not fit in one image, cranial and caudal thoracic measurements were summed (Fig. 2).

Results

- Median age: 3.50 years (range 0.67 - 14 years)
- Median weight: 18.10 kg (range: 2.60 - 31.81 kg)

Table 1: Comparison of the Total and Segmented Measurements for Assessing Percent Change in Thoracic Dimension in all 44 Dogs

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Segmented</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median</td>
<td>12.46</td>
<td>20.81</td>
</tr>
<tr>
<td>Range</td>
<td>8.90-26.08</td>
<td>12.75-39.24</td>
</tr>
<tr>
<td>CI</td>
<td>8.91-23.97</td>
<td>14.32-37.61</td>
</tr>
</tbody>
</table>

Total: measurement of entire thoracic cavity; Segmented: measurement excludes mediastinum and cardiac silhouette; CI: confidence interval

Table 2: Comparison of the Single Frame and Summated Methods for Quantifying Percent Change in Thoracic Dimension Using Both Total and Segmented Measurements

<table>
<thead>
<tr>
<th></th>
<th>Single Frame:</th>
<th>Summated:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Segmented</td>
</tr>
<tr>
<td>Median</td>
<td>13.83</td>
<td>22.37</td>
</tr>
<tr>
<td>CI</td>
<td>9.21-24.91</td>
<td>17.53-38.34</td>
</tr>
</tbody>
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Single Frame: method used on dogs whose thoracic cavity fit within the imaging frame; Summated: method used on dogs whose thoracic cavity did not fit within the imaging frame; CI: confidence interval

Conclusion

- Fluoroscopy offers a noninvasive method for assessing lung area changes in healthy dogs.
- Segmented measurements of the thoracic cavity yield a more clinically-applicable reference range since most ILDs will result in reduced compliance.
- We recommend using the segmented reference range of 14.3-37.6%.
- Further studies are needed in dogs with respiratory disease to determine the clinical application of fluoroscopically measured increases and decreases in percent lung area change.

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References: