Purpose:
To quickly and automatically identify the slice coordinates of the thoracic vertebrae (T1 through T12) in CT with an accuracy of two vertebrae.

Methods:
The vertebra identification method uses three stages: (1) thumbnail generation, (2) ridge regression, and (3) application of anatomic constraints. In the first stage, axial slices of the CT are selected from the volume, cropped and resampled into thumbnail images with resolution 16x16 pixels. Next, the thumbnails are assigned a vertebrae number using a ridge regression filter. The filter is trained using hand-labeled data, and training parameters are tuned using cross-validation. Finally, the outputs from the regression filter are fit with a linear spline using anatomic constraints on the size and orientation of vertebrae seen in training data.

Results:
Our method was trained on a data set of twenty thoracic CT scans, and tested using an independent set of ten scans. The CT images are derived from the RIDER and RIDER Pilot studies, and have slice thickness that range between 1.25 and 5 mm. The ridge regression results were found to be smooth and monotonic in the central region, but became non-monotonic near the inferior and superior borders of the image where there is no training data. The anatomically constrained fit generally provides a good fit for the ridge regression output. Results from the independent test set demonstrate successful labeling within 2 vertebrae for 60% of the cases, and within 1 vertebra for 40% of the cases. The most common cause of failure was inaccuracy of the ridge regression stage.

Conclusions:
Ridge regression is a promising approach for assigning anatomic labels to CT images. We envision using this technique as a pre-processing stage for both image registration and image segmentation.