Lung airway geometry as an early predictor of autism: A preliminary machine learning-based study

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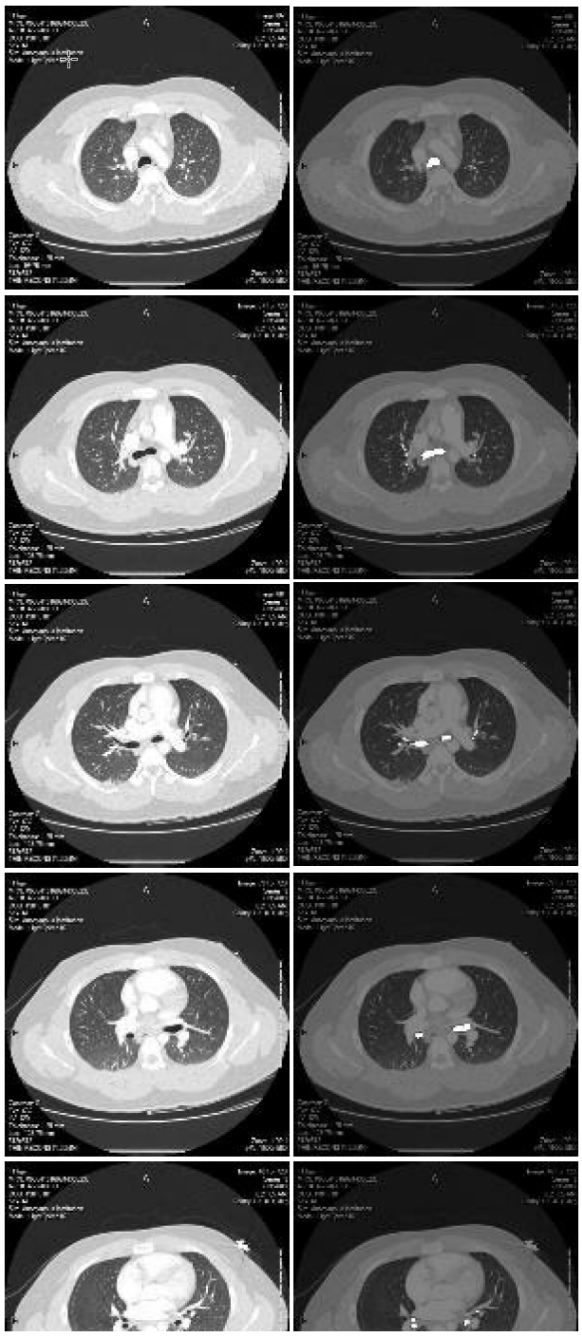
Introduction: This study aimed to determine whether a measurable difference exists in conductive airway geometry between a control population and children with autism spectrum disorder (ASD) using chest computed tomography (CCT) images, with the goal of identifying a biomarker for ASD.



Methods and Materials: 31 CCTs of children with ASD and 23 healthy controls were identified. Principal component analysis (PCA) and support vector machine (SVM) identified significant anatomic parameters. Manual measurements of airway angles from multiplanar reconstructed CCT images were also performed.

Results: The combined PCA and SVM approach achieved an accuracy of nearly 89% using a feature set of 8 airway branching angles. Sensitivity was 94%, but specificity only 78%. The decision rule derived from this approach was tested on manual angle measurements to assess clinical feasibility.

Discussion: Early diagnosis and treatment of ASD is a clinical and public health challenge. Given the pervasiveness of ASD and improved effectiveness of early interventions, biomarkers are needed for early detection. Non-behavioral diagnostic branching of bronchi in generations 3 and 4) were associated with autism, but these anomalies have not been quantified as biomarkers. Our study provides quantitative, statistical analysis of airway geometric parameters predicting autism, derived from CCT. This is the only other study evaluating anatomic airway anomalies in ASD.

Conclusion: There is probably a detectable difference in airway branching angles between children with ASD and healthy controls. However, the significance and clinical applicability of this difference is uncertain. We detected airway anomalies in the same airway generations as prior researchers. Further investigation is needed to evaluate airway anomalies in children with ASD and determine feasibility of this as a biomarker to identify disease.

Figure 1: Typical slices through a CCT. Left: raw scans. Right: CT scans with airways flood-filled with white.