Cardiac Rotation Angle and Severity Classification Assessment of Pectus Excavatum for Improved Diagnosis and Treatment Planning

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Introduction: Pectus excavatum (PE) is the most common congenital deformity of the chest, accounting for 90% of all congenital chest wall abnormalities [1]. It is characterized by a depression of the anterior chest wall, which can lead to symptoms such as exercise intolerance, chest pain with exertion, and shortness of breath [2]. The primary cause of these symptoms is thought to be heart compression, rather than lung limitation [3]. While PE is typically diagnosed based on the appearance of the chest wall, its severity and cardiac function can be accurately assessed using quantitative imaging, including indicators like the cardiac rotation angle.
Objective: This study aims to assess the correlation between CT-derived measures of cardiac rotation angle and PE severity t**o** aid in our understanding of this condition to guide diagnosis treatment plans.

Methodology: Chest computed tomography (CT) scans of PE patients ages 12-16 years were sourced from Wake Forest Baptists Health medical records to identify patients with ICD diagnosis codes for PE and CPT codes for chest region CT scans. CT scans were retrieved from the clinical PACS system. Out of the 49 scans collected, 7 female and 30 male subjects were chosen based on adequate scan quality. Measurement tools in TeraRecon were used to identify thoracic dimensions to calculate the cardiac rotation angle (CRA), Haller Index (HI), and Correction Index (CI) for each subject. The CRA was defined as the angle between the cardiac apex and the line between the anterior vertebral corpus and spinous process [4]. HI is the ratio of the width and height of the thorax, which was calculated by dividing the maximum transverse diameter of the chest by the narrowest anterior-posterior (AP) length of the chest [5]. The minimum AP distance was measured from the anterior spine to the posterior sternum. CI, the percent of chest depth correction needed, was calculated by dividing the difference between the minimum and maximum AP distance by the maximum AP distance [6]. HI measurements were utilized to categorize each subject's PE severity as mild (HI 2.0-3.2), moderate (HI 3.2-3.5), or severe (HI > 3.5). Although HI was the main measurement used for classification, CI measures offered additional validation of severity. Linear regression was performed to assess the relationship between the variables, with the coefficient of determination (R^2) quantifying the variance explained by CRA. An F-test evaluated the overall significance of the regression model.

Results: Out of the 37 subjects analyzed, 15 were categorized with mild PE, 7 with moderate PE, and 15 with severe PE. As severity increased, CRA increased (mild median 37.6°±13.1, moderate median 44.83°±13.6, severe median 51°±13.2). Associations between CRA and HI were significant and positive (R^2: 0.24, p-value = 0.002) while associations between CRA and CI were not significant (R^2: 0.01, p-value = 0.5547).

Conclusions: Although the data from this study represents only a small sample of the pediatric PE population, it provides clinically valuable insights into the disease to guide treatment planning and surgical interventions.

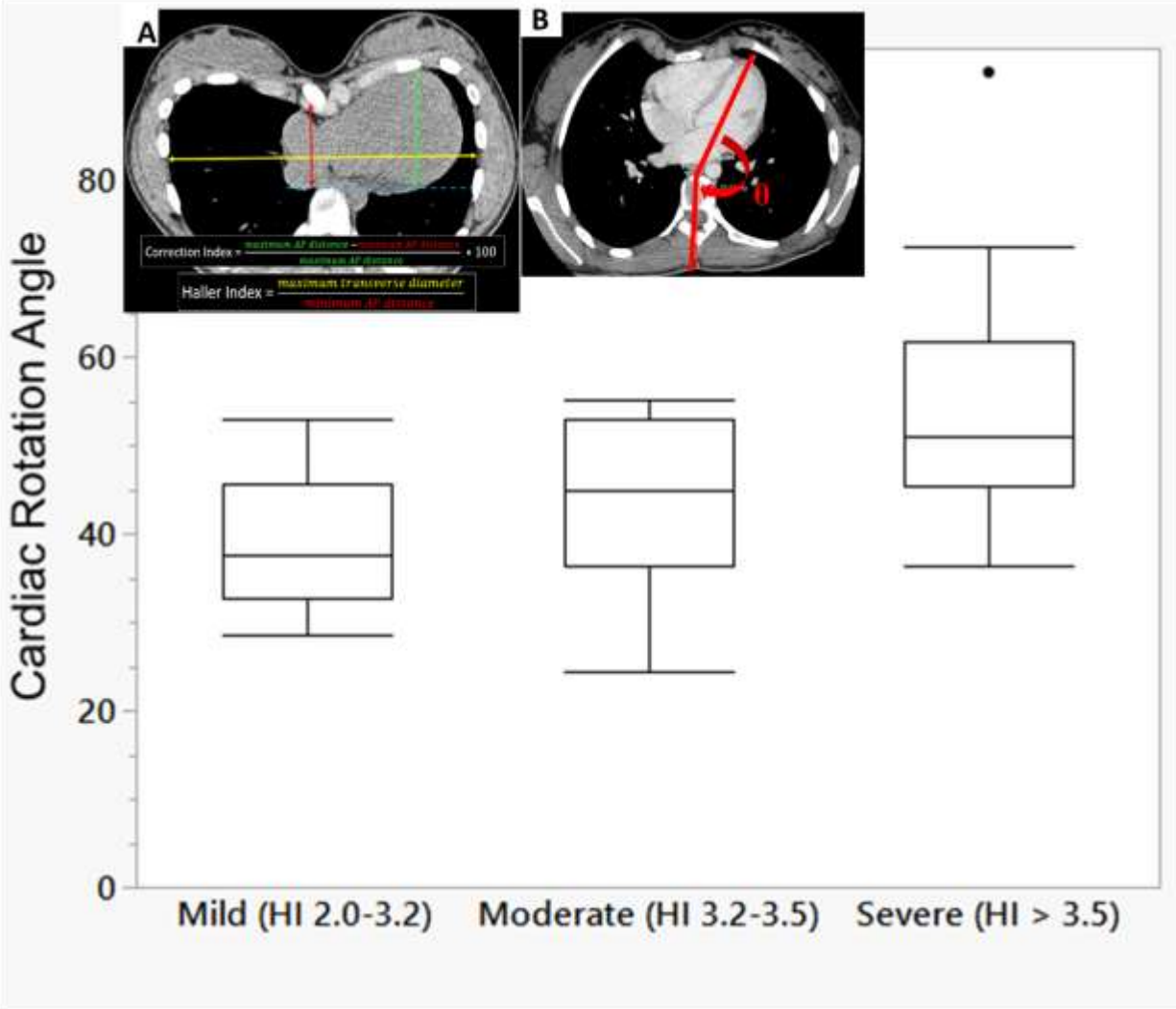

Figure 1. Cardiac rotation angle at mild, moderate, and severe PE with method of calculation for HI, and CI (A), and cardiac rotation angle (B).

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