



CT Based Thoracic Morphometry Reveals a Flattened Chest Phenotype in Non-Small Cell Lung Cancer: A Cross Sectional Study



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INTRODUCTION

Thoracic cage geometry undergoes well-characterized age-related changes, including increased anteroposterior (AP) diameter and progressive rounding due to kyphosis and costal cartilage calcification. While thoracic morphology directly governs intrathoracic pressure dynamics, lymphatic flow, and pulmonary vascular geometry, no study has systematically investigated the relationship between chest wall shape and lung cancer. We hypothesized that patients with non-small cell lung cancer (NSCLC) exhibit distinct thoracic morphometric features compared to cancer-free controls.

METHODS

This cross-sectional study included 99 surgically resected NSCLC patients (49 N0, 50 N2; all adenocarcinoma or squamous cell carcinoma) and 80 cancer-free controls. Three linear thoracic dimensions were measured on preoperative chest CT at the level of the carina: transverse diameter (En), anteroposterior diameter (AP), and craniocaudal height.(Figure 1,2) Derived metrics included the AP/En ratio (chest roundness index; higher values indicate rounder cross-section), En/AP ratio (flattening ratio), ellipsoid volume, cross-sectional area, and sphericity index. Given a significant age difference between groups (controls: 50.8±20.7 years; cancer: 64.2±8.2 years), the primary analysis was performed on an age-matched subset of controls aged ≥50 (n=43, mean age 67.7±10.6 years) versus the cancer cohort. Mann-Whitney U test, Kruskal-Wallis test with Spearman trend analysis, multivariable logistic regression, and bootstrap AUC with 10,000 iterations were used.

DISCUSSION AND CONCLUSION

NSCLC patients exhibit a cancer-specific flattened thoracic phenotype that is independent of age, sex, tumor size, and location, and runs counter to the expected age-related rounding of the chest wall. This morphometric distinction may reflect altered intrathoracic pressure dynamics and lymphatic flow geometry. To our knowledge, this is the first study linking CT-derived thoracic cage shape with lung cancer status. Prospective validation in screening cohorts is warranted.

REFERENCES & ACKNOWLEDGEMENTS

Artificial Intelligence (AI) Use Disclaimer

Artificial intelligence (ChatGPT, OpenAI) was used for language editing. All scientific content, analyses, interpretations, and final presentation were reviewed and approved by the author.

RESULTS

In the age-matched comparison (n=43 controls vs. n=99 cancer), cancer patients exhibited significantly flatter thoracic cross-sections: AP/En ratio was 0.44±0.07 vs. 0.48±0.07 (p=0.003; Cohen's d=0.57; bootstrap AUC=0.66, 95%CI 0.56-0.76), and sphericity was 0.87±0.05 vs. 0.90±0.04 (p=0.009; d=0.49; AUC=0.64, 95%CI 0.54-0.73). Transverse diameter was greater in cancer patients (264±22 vs. 254±23 mm, p=0.02). Critically, volumetric parameters (ellipsoid volume, cross-sectional area) showed no difference (p>0.65), confirming the finding is a shape—not size—distinction. In multivariable logistic regression adjusting for age and sex, AP/En remained an independent predictor of cancer (likelihood ratio test p=0.014). A three-group gradient analysis (Normal→N0→N2) demonstrated monotonically decreasing roundness: AP/En 0.475→0.445→0.427 (Kruskal-Wallis p=0.006; Spearman trend p=-0.27, p=0.001), and sphericity 0.895→0.879→0.867 (p=0.018; p=-0.24, p=0.005). In the normal control group, age correlated positively with AP/En (Spearman p=+0.72, p<0.0001), confirming expected age-related rounding. The cancer-associated flattening therefore opposes the physiological aging trajectory. No barrel chest morphology (AP/En≥0.70) was identified in the cancer cohort (0/99). T stage and tumor location showed no association with thoracic shape (p>0.45).

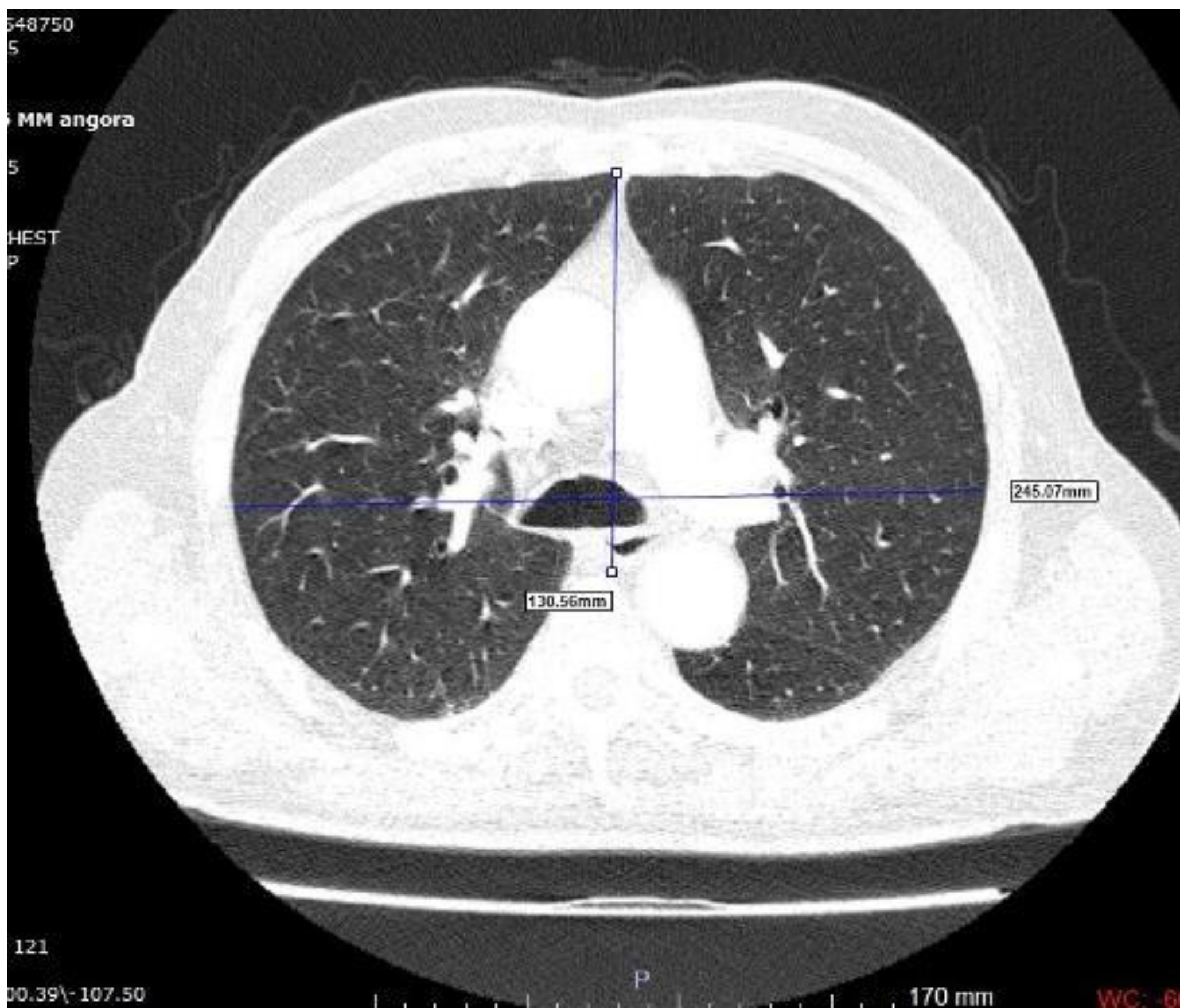


Figure1: CT Scan of Transvers Diameter and AP Diameter

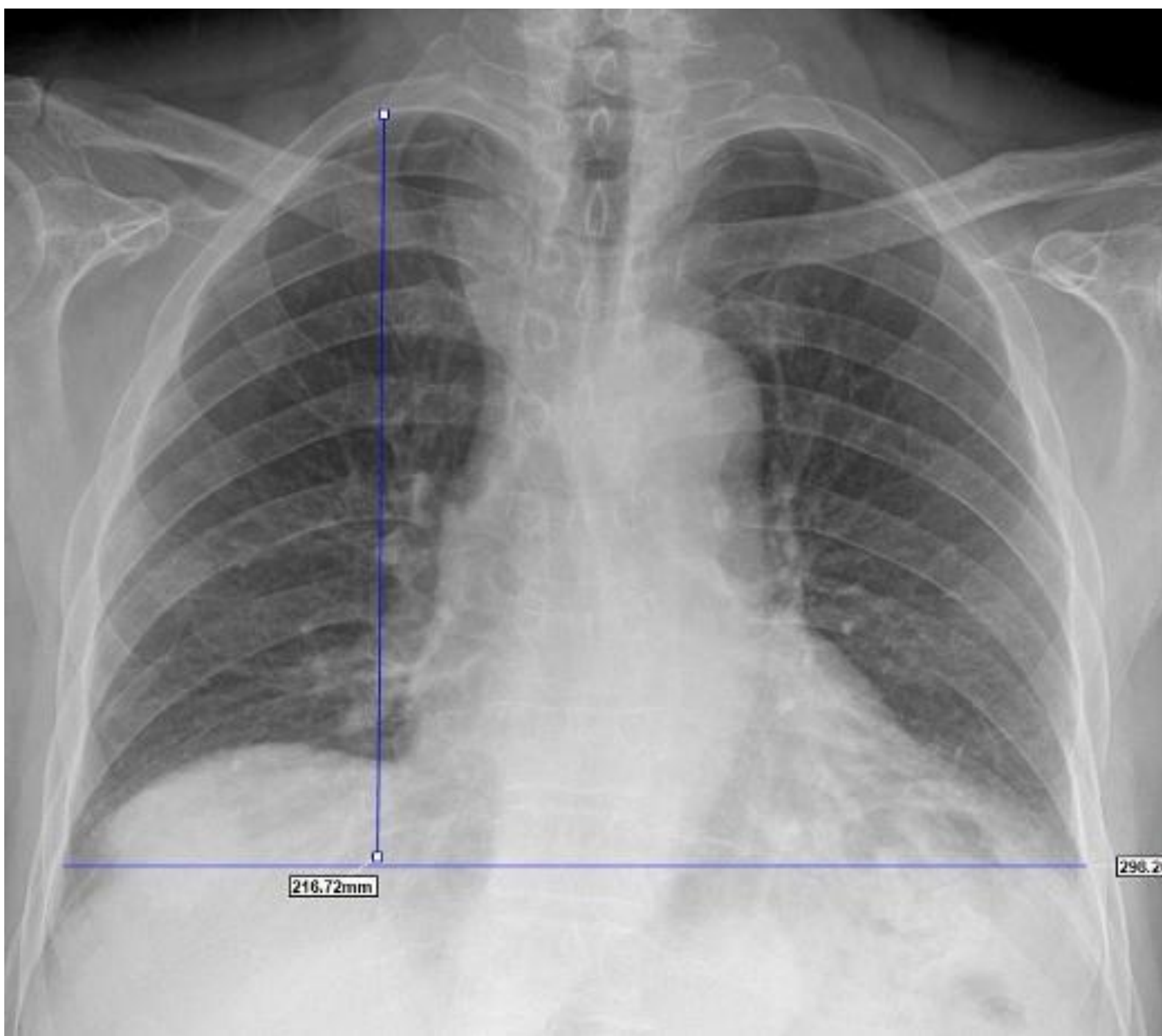


Figure 2: Chest X-Ray Height Measurement