

Computed Tomography Derived Vascular Injury Marker Correlates With Forced Expiratory Volume In One Second (fev1) Loss In World Trade Center Exposed Fire Fighters

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Rationale: An increased ratio of pulmonary artery to aorta (PA/A) diameter, as a marker of vascular injury, measured by computed tomography (CT) predicts future exacerbations in patients with chronic obstructive pulmonary disease (COPD) Wells et. al. NEJM. World Trade Center (WTC) exposed fire fighters have developed respiratory symptoms and a subset had a decline in pulmonary function. Our group has previously shown that systemic biomarkers of inflammation and cardiovascular disease predict this decline. We hypothesize that a PA/A ratio ≥ 1 will be associated with a decline in FEV₁.

Methods: From a baseline cohort of never smokers with normal spirometry pre 9/11, cases and controls were selected. Cases had FEV₁ fall to less than the lower limit of normal ($< LLN$), and controls had preserved lung function, see figure 1. Spirometry was performed according to ATS/ERS guidelines. Inspiratory series CT images, collected contemporaneously with spirometry, were retrospectively assessed using iSite PACS, (Philips iSite Enterprise, Version 3.6.114; www.healthcare.philips.com). The diameter of the main PA at the level of its bifurcation and the diameter of the ascending aorta in its maximum dimension were recorded using the same image. ES, who was blinded to group assignment, made all measurements. Statistics and data management were performed using SPSS.

Results: CT images were available for 91 patients in the case/control cohort. Body mass index (BMI), age, exposure and pulmonary function data are shown in Table 1. Exposure intensity, age at exposure, time from 9/11 to spirometry and to CT were similar. BMI was increased in cases compared to controls. The mean PA diameter and PA/A ratio were increased in cases ($p=0.05$, 0.09), the mean A diameter was similar. Using binary logistic regression the odds ratio of having an FEV₁ $< LLN$ if the PA/A ratio was ≥ 1 was 3.6 ($p=0.047$), when corrected for exposure, age at 9/11 and BMI.

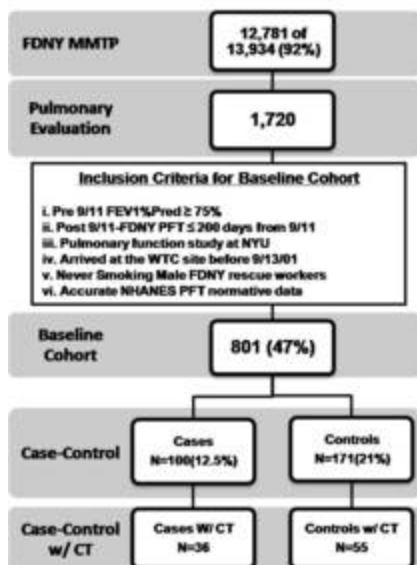
Conclusions: In this preliminary study a PA/A ratio ≥ 1 was associated with WTC related decline in FEV₁. There are several potential confounders. Data on the presence of congestive heart failure, sleep apnea and other comorbidities are presenting lacking. Additionally, patient effort and respiratory system compliance may influence inspiratory measurements of the PA. In future studies, we plan to analyze expiratory CT images and correlate with other markers of heart disease. Increased PA/A represents another potentially useful non-invasive tool to assess for obstructive lung dysfunction and warrants further study.

Table 1:

| Table 1: Demographics | | Cases N=36 | Controls N=55 | p† |
|--|-----------------|---------------|------------------|--------|
| WTC Arrival Time* | Morning 9/11 | 12(33) | 17(31) | 0.81 |
| | After 12pm 9/11 | 24(67) | 38(69) | |
| 9/11 to Spirometry, Months† | | 36(27-52) | 35(20-58) | 0.72 |
| 9/11 to CT Scan, Months† | | 50(33-67) | 58(30-70) | 0.71 |
| Spirometry to CT Scan, Months† | | 0(0-18) | 0(0-17) | 0.78 |
| BMI at Spirometry, kg/m ² † | | 31(29-34) | 29(27-31) | 0.002 |
| Years of Service at 9/11† | | 15(7-20) | 14(7-18) | 0.31 |
| Age at 9/11† | | 43(36-47) | 42(37-44) | 0.76 |
| FEV1 % Predicted † | | 73(65-74) | 95(88-98) | <0.001 |
| FVC % Predicted † | | 76(72-84) | 96(90-101) | <0.001 |
| FEV1/FVC† | | 74(64-78) | 78(75-82) | 0.006 |

*Expressed as N (%); †Expressed as Median (Inter Quartile Range)
 ‡Significance assessed by Mann-Whitney U test between Cases and Control

Figure: 1



Flow Diagram of Selection Criteria

Table 2: Vascular Measurements by CT

| | Cases N=36 Mean(SD) | Controls N=55 Mean(SD) | p |
|-------|------------------------|---------------------------|------|
| PA mm | 29.4(3.5) | 27.9(3.3) | 0.05 |
| A mm | 32.2(3.6) | 31.8(3.2) | 0.6 |
| AP/A | 0.92(0.11) | 0.88(0.09) | 0.09 |

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