Original Investigation

Association Between Expiratory Central Airway Collapse and Respiratory Outcomes Among Smokers

Surya P. Bhatt, MD; Nina L. J. Terry, MD, JD; Hrudaya Nath, MD; Jordan A. Zach, MS; Juerg Tschirren, PhD; Mark S. Bolding, PhD; Douglas S. Stinson, MSBA, MSIS; Carla G. Wilson, MS; Douglas Curran-Everett, PhD; David A. Lynch, MD; Nirupama Putcha, MD; Xavi Soler, MD, PhD; Robert A. Wise, MD; George R. Washko, MD; Eric A. Hoffman, PhD; Marilyn G. Foreman, MD; Mark T. Dransfield, MD; for the Genetic Epidemiology of COPD (COPDGene) Investigators

IMPORTANCE Central airway collapse greater than 50% of luminal area during exhalation (expiratory central airway collapse [ECAC]) is associated with cigarette smoking and chronic obstructive pulmonary disease (COPD). However, its prevalence and clinical significance are unknown.

OBJECTIVE To determine whether ECAC is associated with respiratory morbidity in smokers independent of underlying lung disease.

DESIGN, SETTING, AND PARTICIPANTS Analysis of paired inspiratory-expiratory computed tomography images from a large multicenter study (COPDGene) of current and former smokers from 21 clinical centers across the United States. Participants were enrolled from January 2008 to June 2011 and followed up longitudinally until October 2014. Images were initially screened using a quantitative method to detect at least a 30% reduction in minor axis tracheal diameter from inspiration to end-expiration. From this sample of screen-positive scans, cross-sectional area of the trachea was measured manually at 3 predetermined levels (aortic arch, carina, and bronchus intermedius) to confirm ECAC (>50% reduction in cross-sectional area).

EXPOSURES Expiratory central airway collapse.

MAIN OUTCOMES AND MEASURES The primary outcome was baseline respiratory quality of life (St George's Respiratory Questionnaire [SGRQ] scale 0 to 100; 100 represents worst health status; minimum clinically important difference [MCID], 4 units). Secondary outcomes were baseline measures of dyspnea (modified Medical Research Council [mMRC] scale 0 to 4; 4 represents worse dyspnea; MCID, 0.7 units), baseline 6-minute walk distance (MCID, 30 m), and exacerbation frequency (events per 100 person-years) on longitudinal follow-up.

RESULTS The study included 8820 participants with and without COPD (mean age, 59.7 [SD, 6.9] years; 4667 [56.7%] men; 4559 [51.7%] active smokers). The prevalence of ECAC was 5% (443 cases). Patients with ECAC compared with those without ECAC had worse SGRQ scores (30.9 vs 26.5 units; $P < .001$; absolute difference, 4.4 [95% CI, 2.2-6.6]) and mMRC scale scores (median, 2 [interquartile range [IQR], 0-3]) vs 1 [IQR, 0-3]; $P < .001$]), but no significant difference in 6-minute walk distance (399 vs 417 m; absolute difference, 18 m [95% CI, 6-30]; $P = .30$), after adjustment for age, sex, race, body mass index, forced expiratory volume in the first second, pack-years of smoking, and emphysema. On follow-up (median, 4.3 [IQR, 3.2-4.9] years), participants with ECAC had increased frequency of total exacerbations (58 vs 35 events per 100 person-years; incidence rate ratio [IRR], 1.49 [95% CI, 1.29-1.72]; $P < .001$) and severe exacerbations requiring hospitalization (17 vs 10 events per 100 person-years; IRR, 1.83 [95% CI, 1.51-2.21]; $P < .001$).

CONCLUSIONS AND RELEVANCE In a cross-sectional analysis of current and former smokers, the presence of ECAC was associated with worse respiratory quality of life. Further studies are needed to assess long-term associations with clinical outcomes.

JAMA. 2016;315(5):498-505. doi:10.1001/jama.2015.19431

Supplemental content at jama.com

Author Affiliations: Author affiliations are listed at the end of this article.

Group Information: A list of the COPDGene Investigators was published in *JAMA Intern Med*. 2015;175(9):1539-1549.

Corresponding Author: Surya P. Bhatt, MD, Division of Pulmonary, Allergy and Critical Care Medicine, University of Alabama at Birmingham, THT 422, 1720 Second Ave S, Birmingham, AL 35294 (spbhatt@uab.edu).