

PROGRESS REPORT: Pleural plaques and their effect on pulmonary function in Libby vermiculite miners

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Background: Pleural plaques (PP) are the most common radiological finding consistent with asbestos exposure. Multiple studies have investigated the relationship between PP and pulmonary function with disparate and inconsistent results. Most of these studies used chest radiographs to determine the presence of PP and used reduced FVC alone as a surrogate measure of restrictive ventilatory impairment. In general, these studies were also inconsistent in controlling for the effects of smoking, BMI, and the evaluation of obstructive ventilatory impairment. The use of computerized tomography increases diagnostic capability for PP to approximately 93% sensitivity. The primary purpose of this investigation to determine whether or not there is a statistically significant association between the presence of asbestos-related PP alone, and a loss of lung function through the use of High Resolution CT [HRCT] imaging.

Methods: Cross-sectional analysis was performed from a systematic chart review of vermiculite miner medical records applying for enrollment or enrolled in the Libby Medical Program between January, 2,000 and August, 2012. Eligible participants were former male miners with complete pulmonary function testing (PFT) and corresponding peer-reviewed thoracic HRCT/ CT imaging performed within five years of each other. The most recent PFT/CT pairing was used. All participants were at "baseline" during testing, with no acute pulmonary conditions. We applied multivariate linear, log-binomial, and multinomial logistic regressions to estimate prevalence ratios and determine the association between the presence of only pleural plaques and abnormal lung function. Covariate adjustment was made for age, BMI, smoking history, duration of employment, and years since last occupational asbestos exposure. Asbestos fiber exposure levels and duration of exposure were not determined.

Results: Records were reviewed for 180 miners with inclusion of 166 individuals between 43-89 years of age. All participants were Caucasian males, with an average time since last occupational asbestos exposure being 31.4 years. Over 70% of miners were current or former smokers with an average smoking history of 33.8 pack-years. Fifty percent (n=83) were considered obese with average BMI of 30.3 kg/m² (SD 5.56). 90% of miners (n=149) showed CT evidence for pleural plaques (PP). Most PP were calcified (n=95) and bilaterally distributed (n=137) within the thoracic cavity. Of the 149 miners with PP, 89 (53.6%) had PP alone, 27 (16.3%) had both pleural plaques and interstitial fibrosis (PPIF), and 34 (20.5%) had other pleuropulmonary findings (ACTA). Pulmonary nodules > 1cm diameter, diffuse pleural thickening, and rounded atelectasis were some of the findings contained within the ACTA group. CT results showed that 16 (9.6%) of miners exhibited no evidence for asbestos related pulmonary findings (No ARPF). Seventy-four (44.6%) of the LMF miners had abnormal PFTs. No significant differences were noted for the prevalence of abnormal lung function between the PP and No ARPF groups (PR=0.973 (0.44,2.15), p=0.946). In addition, NHANES percent predicted parameter values showed no statistically significant differences between the PP and No ARPF groups. Significant group differences for mean TLC, FVC, FEV₁, and D_LCO were found for the PPIF and ACTA groups when compared to those with no ARPF. PPIF miners had significantly lower mean TLC and D_LCO NHANES percent predicted values (p=0.02 and p=0.05, respectively). ACTA miners also had significantly lower values for mean FEV₁, FVC, and D_LCO (p=0.02, p=0.05, and p=0.008, respectively). Age, cumulative smoking, and BMI were significant covariates (Age F=13.68 p=0.0003; Smoking F=14.6 p<0.0001; BMI F=6.77, p=0.01). After covariate adjustment, miners with PPIF were almost 2.5 times more likely to have abnormal lung function than those with No ARPF (PR: 2.49 (1.06,5.88), p=0.04)..

Conclusion: The increased sensitivity of HRCT imaging improved our ability to compare the relationship between asbestos exposed Libby vermiculite miners with PP alone and their association with lung function following asbestos exposure. These results add to the weight of evidence that there is no significant decrement in lung function in miners with localized PP alone when additional covariates are considered.