Deep-Learning Quantification of Coronary Calcium on CT and Mortality in the National Lung Screening Trial (NLST)

Tuesday 9:00-9:10 AM | RC303-02 | Room: E350

PURPOSE

Coronary artery calcification (CAC) is quantifiable on low-dose chest CT and can guide statin therapy. Quantification is not routinely performed due to time and equipment limitations. We developed a deep-learning algorithm that automatically quantifies coronary calcium on standard lung screening CT and evaluated prognostic value in 14,959 National Lung Screening Trial (NLST) participants.

METHOD AND MATERIALS

The deep learning algorithm was developed in 1,600 cardiac CTs from with manual CAC measurement as the reference. The deep learning calcium score was categorized as: High (CAC>300), Moderate (CAC: 101-300), Low (CAC: 1-100), and Very Low (CAC: 0). The association of the deep learning calcium score with all-cause and cardiovascular mortality was then tested in 14,959 heavy smokers aged 55-74 having lung cancer screening chest CT at 33 US sites in NLST. The intraclass correlation coefficient (ICC) between automated and human manual CAC was assessed in 396 NLST chest CTs.

RESULTS

All-cause (7.3% (1,092/14,959)) and cardiovascular (1.9% (288/14,959)) mortality was assessed over median follow-up of 6.5 years. There was a significant association between deep learning calcium score and all cause mortality: High: HR 2.9 (95%CI: 2.4-3.5), Moderate: 1.9 (1.5-2.3), Low: 1.3 (1.1-1.6), all p<0.01 compared to Very Low; as well as for cardiovascular mortality: High: HR 6.6 (4.3-10.3), Moderate: 3.8 (2.3-6.1), Low: 2.2 (1.4-3.6), all p<0.001 compared to Very Low. The ICC between manual and automatic calcium classes was 0.858 (95%CI: 0.830-0.882).

CONCLUSION

The automated deep learning algorithm quantified CAC on lung screening CT. Automated CAC corresponded closely to human readers and was strongly associated with all-cause and cardiovascular mortality in a large multicenter cohort of NLST participants having lung screening.

CLINICAL RELEVANCE/APPLICATION

Automated quantification of coronary calcium using existing lung screening CTs identifies persons at high and low risk to guide cardiovascular prevention.