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Coronary 18F-sodium fluoride uptake predicts progression of coronary arterial calcification

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Background: Combined positron emission tomography and computed tomography (PET-CT) using 18F-sodium fluoride (18F-NaF) to detect microcalcification provides the opportunity to gain important insights into disease activity in coronary atherosclerosis. However, the relationship between 18F-NaF uptake and progression of coronary calcification has not been determined.

Purpose: To determine the relationship between 18F-NaF uptake and progression of coronary calcification in patients with clinically stable coronary artery disease (CAD).

Methods: Patients with established, multivessel CAD underwent 18F-NaF PET-CT and CT coronary calcium scoring at baseline, with repeat CT calcium scoring at one year. Coronary arterial PET uptake was analysed qualitatively and semi-quantitatively in diseased vessels by measuring maximum tissue-to-background ratio (TBRmax) – defined as the maximum standardised uptake value in a plaque divided by mean blood pool activity measured in the right atrium. Coronary calcification was quantified by measuring calcium mass, volume, average calcium density and total Agatston score (AU).

Results: In total, 185 patients underwent baseline and repeat imaging (median age 66 years, 80% men), and 118 (64%) had increased 18F-NaF uptake in at least one vessel. Median total calcium score, volume, mass and average density were higher in patients with compared to those without increased 18F-NaF uptake (Table 1). At one year, patients with evidence of increased 18F-NaF uptake demonstrated more rapid progression of coronary calcification (97 [39–166] AU) versus those without uptake (35 [7–93] AU; $p<0.0001$). Amongst 18F-NaF-positive patients, the calcium score increased only in coronary segments with 18F-NaF uptake (baseline 90.5 [27.5–202] AU versus one year 135.5 [59.3–281.8] AU; $p<0.0001$) and not in 18F-NaF-negative segments (baseline 44.5 [16–110.5] AU versus one year 46.5 [18.25–114] AU; $p=0.446$). There was a moderate correlation between TBRmax and change in total calcium score, volume and mass at 1 year (Spearman's Rho = 0.37, 0.38, 0.46 respectively; $p<0.0001$ for all).

Conclusions: Coronary 18F-NaF uptake identifies both patients and individual coronary segments with greater disease and more rapid progression of coronary calcification over one year.

Coronary calcification at baseline in PET-negative and PET-positive patients

	All patients (n=185)	18F-NaF Positive (n=118)	18F-NaF Negative (n=67)	P value
Agatston Score (AU)	381 [107–892]	541 [245–1130]	136 [55–361]	p<0.0001
Calcium Volume (mm^3)	358 [131–787]	506 [251–1014]	131 [64–343]	p<0.0001
Calcium Mass (mg)	71 [23–155]	100 [48–222]	24 [11–69]	p<0.0001
Average Density (mg/mm^3)	0.19 [0.17–0.22]	0.20 [0.18–0.23]	0.18 [0.16–0.20]	p<0.0001