burden and CV risk (5). There is no doubt that an increasing Agatston score (the most common measure of CAC) is associated with increasing overall atherosclerosis and more CV events. What we need to identify is the best method to abate or slow the atherosclerosis process, which is still under active investigation, and whether acting on CAC progression can potentially alter future CV events.

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REFERENCES

1. Mori H, Torii S, Kutyna M, Sakamoto A, Finn AV, Virmani R. Coronary artery calcification and its progression: what does it really mean? J Am Coll Cardiol Img 2018;11:127–42.

2. Yeh Y, Nakanishi R, Budoff MJ. Coronary artery disease progression: insights from cardiac CT. Curr Cardiovasc Imaging Rep 2015;8:24–32.

3. Budoff MJ, Young R, Lopez VA, et al. Progression of coronary calcium and incident coronary heart disease events: the Multi-Ethnic Study of Atherosclerosis. J Am Coll Cardiol 2013;61:1231–9.

4. Budoff MJ, Hokanson JE, Nasir K, et al. Progression of coronary artery calcium predicts all-cause mortality. J Am Coll Cardiol Img 2010;3:1229–36.

5. Ceponiene I, Nakanishi R, Osawa K, et al. Coronary artery calcium progression is associated with coronary plaque volume progression: results from a quantitative semiautomated coronary artery plaque analysis. J Am Coll Cardiol Img 2017 Oct 14 [E-pub ahead of print].

THE AUTHORS REPLY:

We read with interest the comment by Drs. Budoff and Tayek on our paper, "Coronary Artery Calcification and Its Progression: What Does It Really Mean?" (1). Drs. Budoff and Tayek are concerned about our lack of citation of studies pertaining to coronary artery calcium (CAC) progression and subsequent cardiovascular events. References 2 and 3 in our paper highlight the role of CAC detection and risk of future events on a population basis. We certainly acknowledge that there are copious data showing an important association between CAC progression and subsequent cardiac events, as referenced by Dr. Budoff and colleagues. Although CAC and its progression can predict generic risk of cardiovascular events, it cannot yet be used prospectively to identify a culprit lesion. Moreover, our review is meant to highlight the complexities of this subject while demonstrating the discrepancy between what is known pathologically and how CAC is currently used in the clinic. Reference 3 in our paper highlights this by showing that whereas CAC volume is positively associated with cardiovascular disease events, at any levels of CAC volume CAC density is inversely and significantly associated with cardiovascular disease events (2). We demonstrate through pathology that patterns of calcification such as sheet calcification correlate more with plaque stability, whereas microcalcification and fragmented calcification correlate with thin cap fibroatheroma and plaque rupture. From a pathological point of view, just looking at CAC score (Agatston score) is not enough to understand fully the complex relationship between vascular calcification and plaque stability or instability. Although it is very practical clinically, it fails to tell when the event will take place or which lesion will cause an event. Based on our current pathological understanding of the subject, we believe the presence of calcium (small, fragmented, spotty) is a better predictor of unstable plaque; however, heavy calcium (diffuse, fibrocalcific plaques, sheet of calcium) is a better predictor of stable plaque. If this type of analysis were to be added to current CAC scoring, perhaps on the basis of higher-resolution computed tomography imaging than is currently available, it could allow us to distinguish better which specific patients are at risk of future events. Identification of patients harboring high-risk plaques may allow for more intensive medical therapy, lowering their risk of future events.

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REFERENCES

1. Mori H, Torii S, Kutyna M, Sakamoto A, Finn AV, Virmani R. Coronary artery calcification and its progression: what does it really mean? J Am Coll Cardiol Img 2018;11:127–42.

2. Criqui MH, Denenberg JO, Ix JH, et al. Calcium density of coronary artery plaque and risk of incident cardiovascular events. JAMA 2014;311:271–8.