Journal of Clinical Densitometry: Assessment & Management of Musculoskeletal Health, vol. ■, no. ■, 1–8, 2016

1094-6950/■:1–8/$36.00
http://dx.doi.org/10.1016/j.jocd.2016.06.002

Original Article

Potential Clinical Impact of Abdominal Aortic Calcification on Bone Density Lateral Spine Images

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Abstract

Abdominal aortic calcification (AAC) predicts incident atherosclerotic cardiovascular disease (ASCVD) events and can be accurately identified on densitometric lateral spine images obtained at the time of bone densitometry. Our objective was to estimate the proportion of patients referred for bone densitometry who have a high level of AAC and are not already known to have ASCVD or to be at high risk for ASCVD. AAC was scored on densitometric lateral spine images of 2168 individuals blinded to clinical diagnoses or risk factors using the 24-point Framingham scale. We ascertained preexisting ASCVD diagnoses and risk factors using electronic health record data. We used the risk calculator of the American Heart Association (AHA) and the American College of Cardiology (ACC) to estimate the 10-yr risk of hard ASCVD outcomes (myocardial infarction, death caused by coronary heart disease, or nonfatal or fatal stroke). A high level of AAC (AAC score ≥5) was present in 41 (6.1%, 95% confidence interval [CI]: 4.4%–8.2%) of those aged less than 65 yr, in 253 (23.1%, 95% CI: 20.7%–25.7%) of those aged 65–74 yr, and in 153 (37.8%, 95% CI: 33.0%–42.7%) of those aged 75–80 yr. Among those aged 65–74 yr, 16.9% (95% CI: 14.7%–19.3%) had a high level of AAC and no prior clinical diagnosis of ASCVD, but only 2.4% had a high level of AAC and a predicted 10-yr risk of hard ASCVD outcomes <7.5%. AAC is common among those aged 65 yr and older who were referred for bone densitometry and had no known ASCVD, although these individuals can also be recognized as being at intermediate to high risk using the AHA-ACC ASCVD risk calculator. Further studies regarding the impact of identification of AAC on provider and patient cardiovascular disease risk management choices are warranted.

Key Words: Abdominal aortic calcification; atherosclerotic cardiovascular disease; bone densitometry; vertebral fracture assessment.

Introduction

Coronary heart disease and stroke, respectively, are the first and third leading single causes of mortality among elderly women *(1)*. Over 60% of women who die of coronary heart disease have no prior symptoms of the disease *(2)*. Clinical risk factors such as hypertension, cigarette smoking, obesity, hyperlipidemia, family history, and diabetes mellitus are used to identify those at high risk of atherosclerotic cardiovascular disease (ASCVD) *(3)*. However, a substantial proportion of those who suffer morbid or fatal cardiovascular disease events are not at high risk when judged by these clinical risk factors *(4,5)*. Electron beam computed tomography (CT) and CT coronary angiography are recommended by some to aid identification of those at high risk of ASCVD, but their use is not widely accepted tests because of their expense and associated radiation exposure *(6)*.

In the Framingham and Rotterdam observational cohort studies, abdominal aortic calcification (AAC) on lateral spine radiographs has been shown to predict incident myocardial infarction, stroke, and peripheral vascular disease *(7–9)*. AAC can also be accurately detected on densitometric

Received 02/27/16; Revised 05/5/16; Accepted 06/17/16.
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lateral spine images obtained for vertebral fracture assessment (VFA) *(10,11)*. AAC on densitometric VFA images is strongly associated with coronary calcium score on electron beam CT *(12)*, with carotid artery intimal medial thickening and stenosis *(13)*, and predicts subsequent myocardial infarction or stroke *(14–16)*. Because VFA is done in conjunction with bone densitometry primarily for individuals aged 65 yr and older *(17)*, it is this subset for whom VFA has the greatest potential to aid identification of those at high risk of incident ASCVD. Among those aged 65–80 yr, lipid-lowering agents have been shown to be effective in reducing incident coronary heart disease *(18)* and cardiovascular disease mortality *(18)*.

However, it remains unclear what proportion of those referred for bone densitometry both have a high level of AAC *and* are not already known to be at high risk for incident ASCVD. Moreover, the latest guidelines of the American Heart Association (AHA) and the American College of Cardiology (ACC) recommend that statin therapy be offered to all women and men aged 40–75 yr with a 10-yr risk of ASCVD outcomes of 7.5% or higher *(19)*, using the pooled AHA-ACC calculator *(20)*. Hence, it is possible that the majority of those aged 65 or older (for whom universal bone densitometry is recommended at least once) would be recommended to be on statin therapy regardless of their AAC level.

Our first objective was to estimate the distribution of AAC in a clinical population of patients who had VFA images done at the time of their bone density test, and to estimate the proportions of those patients with a high level of AAC but who otherwise are not known to have preexisting ASCVD. Our second objective was to estimate the proportions of those aged 65–80 with a high level of AAC, no known clinical ASCVD, and a low risk of incident ASCVD using the current pooled AHA-ACC hard ASCVD risk calculator. Our third objective was to estimate the proportion of those with moderate or high levels of AAC that have suboptimal control of modifiable ASCVD risk factors (systolic blood pressure above 150 mmHg, low-density lipoprotein [LDL] cholesterol level higher than 100 mg/dL, and/or are current smokers).

Materials and Methods

The present study was conducted at the bone densitometry center of a large community integrated health care delivery organization in the Minneapolis–St. Paul metropolitan region, under the auspices of and with the approval of that organization's institutional review board.

Study Patient Population

Since January 1, 2008, VFA has been done at this health care organization at the time of bone densitometry for those with a lumbar spine, total hip, or femoral neck *T*-score ≤–1.5 and one of the following: age ≥65 yr, current height 1.5 inches or more below recalled young adult height, current glucocorticoid use (prednisone 5 mg or more per day or equivalent), or self-reported prior vertebral fracture. All patients (6718) who had axial bone densitometry (HCPCS code 77080) and VFA (HCPCS code 77082) between April 1, 2008, and June 30, 2009, were identified from the electronic health record (EHR), and 2500 of these individuals were randomly selected for study inclusion.

Assessment of AAC

Of these 2500 patients, densitometric lateral spine images used for VFA could be located for 2167. These densitometric images were read by a physician (JTS) experienced in reading AAC on both lateral spine radiographs and densitometric images and blinded to patient characteristics *(10,11,14)* using the Framingham 24-point AAC score (AAC24) developed by Kauppila et al *(21)*. The level of AAC was considered to be none if the AAC24 score was 0, mild to moderate if the AAC24 score was 1–4, and high if the AAC24 score was 5 or higher *(9,21)*.

Ascertainment of Preexisting ASCVD or Diabetes Mellitus

All inpatient stays and outpatient clinical encounters within the 2 yr prior to the date of the densitometric lateral spine image with the associated discharge (or clinic visit associated) diagnosis code were extracted from the EHR. Individuals were considered to have preexisting cardiovascular disease if they had an inpatient discharge diagnosis or outpatient encounter with an appropriate associated diagnosis code (see Appendix) for angina pectoris, coronary heart disease, congestive heart failure, myocardial infarction, transient ischemic attack, cerebrovascular accident, peripheral vascular disease, and/or abdominal aortic aneurysm. Individuals were considered to have preexisting diabetes mellitus if they had 1 inpatient stay or outpatient encounter with an ICD-9 code of 249.xx or 250.xx.

Ascertainment of Clinical Cardiovascular Disease Risk Factors and Estimation of Hard 10-yr ASCVD Risk

We used values of height, weight, systolic and diastolic blood pressure, smoking status, total and high-density lipoprotein (HDL) cholesterol that were recorded in the EHR before but closest temporally to the date of the VFA. Blood pressure values were available for 99.4% of those who had a VFA, a mean 41 d before the VFA date, and cholesterol values were available for 87.3%, a mean 133 d before the VFA date. EHR extracts were also used to ascertain current use of one or more of the following medications: antihypertensive agents (diuretics, beta blockers, calcium channel blockers, angiotensin-converting enzyme inhibitors, angiotensin receptor blockers, central acting agents, and/or direct vasodilator agents), statin medications, other lipid-lowering agents, and antithrombotic agents. The details of the specific names of medications included in the EHR extraction in each of these classes are provided in the Appendix. Use of any of these medications was