ORIGINAL ARTICLE

A Study of Coronary Artery Calcification Score in Diabetic Chronic Kidney Disease (Stage III & IV)

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Abstract

Coronary artery calcification (CAC) in chronic kidney disease patients increases cardiovascular risk, especially in those on hemodialysis. Diabetes mellitus is an independent risk factor for coronary artery calcification in patients with or without renal disease. However, presence of diabetes mellitus in stage III and IV CKD is associated with more severe coronary calcification with advanced atherosclerosis and hence cardiovascular events. CAC scores are a reliable screening tool for cardiovascular disease, CAC scores help predict both incidence of myocardial infarction and death from cardiovascular disease. In this study we compared the CAC score in patients with CKD stage III and IV, with and without diabetes, using multi-detector computed tomography (MDCT). We also observed the association of other risk factors in CKD with CAC.

Key Words

Coronary Artery Calcification, Cardiovascular Risk, Hemodialysis

Introduction

Vascular calcification is a common complication of chronic kidney disease (CKD) and may contribute to the increased cardiovascular disease (CVD) risk in CKD patients. Coronary artery calcification occurs at a younger age group in patients on hemodialysis (1). However, it is never detected in asymptomatic younger patients (2). The incidence of chronic kidney disease (CKD) is increasing day by day and so does the requirement of hemodialysis as a modality of renal replacement therapy.

The importance of cardiovascular risk assessment and management can't be overemphasized by the fact that more patients die of cardiovascular disease rather than due to progression of CKD to higher stages (3).

The enhanced atherogenesis in CKD may be attributable to hypertension and dyslipidemia secondary to CKD (4). The chronic inflammation, oxidative stress, abnormal bone metabolism, hyperhomocysteinemia, malnutrition and anemia are the factors related to CKD that promote atherogenesis (2). The severity of coronary artery calcification is associated with all cause mortality in CKD patients (5). The coronary artery calcification is strongly associated with creation and evolution of atheroma plaques (2).

The Agatston scoring system based on which 5 distinct categories were classified as follows: no evidence of CAC (CAC score = 0), minimal CAC (CAC score = 1-10), mild CAC (CAC score = 11-100), moderate CAC (CAC score = 101-400), and severe CAC (CAC score >400) (6). Calcium-based phosphate binders which are used to treat hyperphosphatemia can lead to hypercalcaemia, adynamic bone disease and coronary artery calcification (7). Diabetes mellitus is an independent risk factor for coronary artery calcification in patients with or without renal disease (8). However, the presence of diabetes mellitus in stage III and IV CKD is associated with more severe coronary calcification and higher scores (5). Besides the use of phosphate binders and presence of diabetes, other risk factors for coronary artery

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calcification include male sex, higher age group, smoking and plasma osteoprotegrin levels. CAC in hemodialysis patients is preceeded by aortic calcification; however CAC progresses faster than aortic calcification (9). The prevalence of coronary plaques increases with progressive deterioration of renal function (10). Coronary angiography (CAG), Electron beam computed tomography (EBCT) and multislice computed tomography (MSCT) have been used to determine CAC, more prognostic information being provided by EBCT than CAG (11).

Material and Methods

The present study was undertaken in Departments of Internal Medicine, Nephrology and Radiodiagnosis, Government Medical College, Jammu for a period of one year , after getting written approval from the Institutional Ethics Committee. The patients with age more than 18 years and stage III or IV CKD as per guidelines by National Kidney Foundation (2002) were enrolled in the study. GFR was calculated by the four variables Modification of Diet in Renal Disease (MDRD) formula. The patients with history of myocardial infarction, coronary revascularisation, stroke and arrhythmias were excluded from the study. The data regarding clinical profile was collected by history taking and all patients were subjected to 64-MDCT scanner (Siemen's Definition AS CT) with prospective electrocardiographic triggering during a single breath hold.

Statistical Analysis

Data was obtained from the entire heart using sequential acquisition. CAC was calculated using Agatston scoring system. The data were interpreted by using SPSS software version 19 for Windows.

Results

A total of sixty patients (known cases of CKD or diagnosed for the first time) were enrolled during the study period, 35(58.33%) being males and 25(41.67%) being females. The mean age of the patients was 51.13±11.83 years. 30(50%) patients were diabetic, 37(61.67%) were smoker, 37(61.67%) were hypertensive and 37(61.67%) were dyslipidemic. 50% of the CKD patients with diabetes were aged more than 45 years.CAC was present in 19(61.29%) of patients in the age group of 41-60 years whereas only 3(21.43%) of the patients in the age group of 18-40 years had coronary calcification (p value 0.001). 24 (40%) of the patients have CKD (Stage III) and 36 (60%) of the patients have CKD (Stage IV).CAC was seen in 35 (58.33%) patients with CKD Stage III or IV out of which 22(62.86%) being diabetic.

Table 1. Clinical Profile of III and IV CKD Patients

Mean age (years)	51.13±11.83
Male: Female	35(58.33%): 25(41.67%)
Diabetes mellitus	30(50%)
Smoking	37(61.66%)
Mean BMI (kg/m^2)	29.30±5.69
Mean SBP (mmHg)	133.10±10.49
Mean serum LDL (mg/dl)	106.81±13.50
CKD Stage III: Stage IV CKD	24(40%): 36(60%)
Coronary artery calcification (CAC)	35(58.33%)

Table 2. Multivariate Regression Analysis of CAC Score and Association with Risk Factors

Parameter	CAC present	CAC absent	p value
Diabetes mellitus	22(73.33%)	8 (26.67)	0.038
Age >40 years	32(91.42%)	3(8.58%)	0.00001
Dyslipidemia	26 (70.27%)	11 (29.73%)	0.01
BMI=30 kg/m^2	23 (85.19%)	4 (14.81%)	0.00001

Discussion

In present study, CAC was present in 35 (58.33%) patients, 22 (62.86%) being diabetic. It can be deduced that 73.33 % diabetic patients with CKD had evidence of coronary artery calcification while only 43.33% non diabetic CKD patients had coronary artery calcification (p value 0.038). Porter *et al* (5) too reported an overall prevalence of CAC of 60% in CKD stage III and IV subjects and observed that when diabetes was present this increased to 74% (5). A significant positive association of dyslipidemia (p value 0.01), age (p value 0.0001) and diabetes (p value 0.038) was observed with coronary artery calcification as was reported by Russo et al. in 2013 (12). In our study, 24(40%) patients had stage III CKD, 36(60%) had stage IV CKD and the mean e GFR of the patients was 28.73±12.06 ml/min.

Koukoulaki *et al.* (13) had similarly reported a mean e GFR of 32.3 ± 12.5 ml/min/1.73 m2 in stage III and stage IV CKD patients and concluded that CAC is more frequent and severe in patients with CKD stage III and IV compared to matched controls with normal renal function. In our study, no association of CAC was found

between sex (p value 0.5), smoking (p value 0.11) and hypertension (p value 0.44).

Conclusion

In conclusion, we found that CAC is common in patients with CKD stages III and IV, particularly in those with diabetes. Data from this study suggested that traditional cardiovascular disease risk factors, which are highly prevalent in the CKD population, are important in the etiology of coronary artery calcification. In this CKD cohort, age, BMI, and dyslipidemia were each associated with of coronary artery calcification.

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