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Assessment of Coronary Artery Calcification in Chronic Dialysis Patients

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Abstract

Coronary artery calcifications (CAC) are highly prevalent in asymptomatic maintenance dialysis patients (MHP), detection and surveillance of such coronary disease could be helpful in clinical practice. In cross-sectional study conducted in our dialysis Unit, including 49 MHP, We have assessed and quantified coronary artery calcification and theirs risk factors. Detection and quantification of coronary calcifications were made by Multi Slice Cardio Tomography (MSCT) a high-speed scanner 64 row. The total volume and the density of calcifications were assessed in six coronary arteries with determination of calcium coronary Agatston score (CCAS). Patients were classified into 2 groups: (1) No or Moderate calcification with CCAS= 0-400; and (1) Severe calcification with CCAS >400. Demographic and biological data were analyzed. Forty nine patients were enrolled in the study (26 men and 23 women), median age was 57 (49-65.00) years, the mean duration of dialysis was 80.43 (57. 00-65.00) months. Diabetes mellitus was the most frequent etiology of end stage renal disease (40.8%). The median CCAS was 22, 00 (00-201.5). 38 patients (77.6 %) showed no or moderate coronary calcification (CCAS=0-400) and severe calcification (CCAS >400) were found in 11 patients (22.4 %). Positive correlation exists between Severe calcification with (CCAS >400) and conventional cardiovascular risk factors such age (p=0, 02), male gender (p=0.05), diabetes (p=0.03) and calcémia (0.03). The AIVA was the first site of calcification (69.4%) followed by the RCA (36.7%) and the Cx A (30.6%). Calcifications were present simultaneously in two coronary arteries in 66% of cases. The number of calcified arteries increased with age (r=0.396, p=0.005). Multi Slice Cardio Tomography (MSCT) seems to be an effective, non-invasive and reusable method to assess and quantify coronary artery calcification and their progression.

Keywords: Coronary artery calcifications; Dialysis patients; Calcium coronary Agatston score

Introduction

Coronary Artery Calcifications (CAC) are highly prevalent, usually asymptomatic and underestimated among maintenance hemodialysis patients (MHP) [1]. Furthermore CAC are strongly associated with diminished survival in MHP [1]. Identification of these high risk patients is important and might improve outcome [2]. Vascular calcification occurring both in the intima and the media of the vessel wall could have different consequences: Intima calcification leads to vascular occlusion whereas media calcification leads to vascular stiffening [1,3]. The aim of this study was the assessment of CAC in MHP by Multi Slice Cardio Tomography (MSCT) and their prevalence and risk factors [4-6].

Patients and Methods

Study Population

Cross-sectional study was conducted in the period from January to March 2013, including 49 MHP in Dialysis Unit of the First Medicosurgical Hospital in Agadir, Morocco. Inclusion criteria were chronic hemodialysis 3 times a week, age ≥ 18 years, hemodialysis vintage ≥ 6 months. Patients with previous coronarography with stents were excluded from study. In patients with a heart rate ≥ 65 beats per minute. Oral b-blockers (metroprolol 50 or 100 mg, single dose, 1 hour before examination) were administered.

Multi Slice Cardio Tomography (MSCT) Protocol

Detection and quantification of coronary calcifications were made by a high-speed scanner helical cardiac acquisition in retrospective mode without injection of contrast was performed from the carina to diaphragm with a slice thickness of 0.6 mm during a single inspiratory breathe hold with ECG synchronization. Forty to 64 slices were obtained for each acquisition.

MSCT Data Analysis

This technique allowed the visualization of the entire length of the coronary tree. The images obtained were interpretable when considered to not containing artifacts related to movement or heartbeat. Various reconstructions in different planes of space were then performed. A calcified coronary plaque was interpreted when comprised of at least three contiguous pixels having a density of ≥ 130 Hounsfield units. The total volume and the density of calcifications were assessed at the epicardial coronary arteries (left coronary artery (LCA) and right coronary artery (RCA)), the Circumflex Artery (Cx A), the Anterior Inter Ventricular Artery (AIVA), the Diagonal Artery (DA) and Posterior Inter Ventricular Artery (PIVA). The Calcium Coronary Agatston Score (CCAS) was achieved by software that incorporates density calcifications, by multiplying the volume of calcification to a weighted density coefficient. The data were interpreted by a single radiologist trained to this technique and uninformed by clinical and biological information (Figure 1). Patients were classified into 2 groups: (1) No or Moderate calcification with CCAS= 0–400; and (1) Severe calcification with CCAS >400.
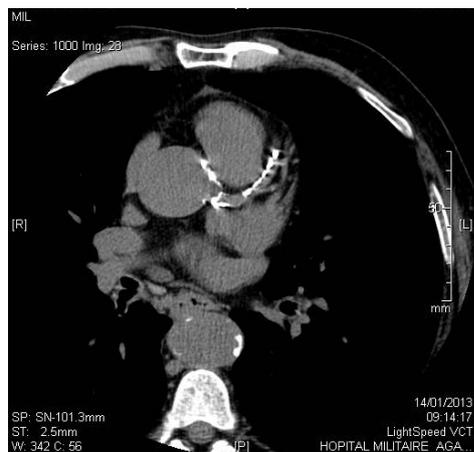
Figure 1: Multi Slice Cardio Tomography

Demographic data

Age, sex, causal nephropathy, dialysis vintage, diabetes, hypertension and average serum levels of calcium, phosphorus, intact parathyroid hormone (iPTH), C-reactive protein (CRP), Low Density Lipoprotein (LDL) cholesterol, during six months.

Statistics SPSS 10.0 statistical software was used for statistical analysis. All variables were assessed by Kolmogrov-Smirnov test and were not normally distributed. Continuous variables were expressed as median ± (25th, 75th percentiles). Categorical variables were expressed as frequency and proportions. Non parametric test (Mann-Withney test) was used to find the relationship between CACS (<400 or >400) and other variables. The significance level was set at 0.05. Spearman test was used to assess correlation between high CACS and others variables.

Results

Forty nine patients were enrolled in the study (26 men and 23 women), median age was 56.47 (57.00-65.00) years, and the median duration of dialysis was 80.43 (57.00-65.00) months.

Age, (years)	57 (49-65)
Male gender, % (nr)	53.1 (26)
Dialysis vintage (months)	67 (50-123)
BMI (kg/m^2)	23 (21.30-26.70)
Diabetes Mellitus, % (nr)	408 (20)
Hypertension, % (nr)	59.2 (29)
Hemoglobin (g/dl)	10.7 (9.5-12.1)
C -Reactive protéine (mg/l)	3.4 (1.9-6.8)
Calcium coronary Agatston score (CCAS)	22 (0-201.5)

Table 1: Baseline demography and clinic characteristics of study patients. Continuous variables are expressed as median ± (25th, 75th percentiles)

Diabetes mellitus was the most frequent etiology of end stage renal disease (40.8%). Baseline demography and clinic characteristics of study patients are summarized in Table 1.

The median CCAS was 22, 00 (00-201.5), 38 patients (77.6%) showed no or moderate coronary calcification (CCAS=0-400) and severe calcification (CCAS >400) were found in 11 patients (22.4%). Positive correlation exists between Severe calcification (CCAS >400) and conventional cardiovascular risk factors such age (0.02), male gender (p=0.05), diabetes (p=0.03) and calcemia (p=0.03). Comparison between these two patients groups are summarized in Table 2.

	No or Moderate calcification with CCAS= 0–400	Severe calcification with CCAS > 400	p
Number (%)	38 (77.6)	11(22.4)	
Age, (years)	54.5 (45-63)	64(57-70)	0.02
Male gender, number (%)	18 (47.4)	8 (72.7)	0.05*
Dialysis vintage (months)	65.5 (49.5-123.2)	73 (54-125)	0.38
Diabètes, number (%)	12 (31.6)	8 (72.7)	0.03*
Calcémia (mg/l)	87 (80-91.25)	91 (89-96)	0.03
Phosphrémia (mg/l)	36 (24.75-48.25)	44 (32-52)	0.13
intact PTH (pg/ml)	494 (250-824.25)	781 (280-1049)	0.54
LDL cholesterol (g/l)	1.05 (0.85-1.26)	1.10 (0.64-1.34)	0.86
C –Reactive Protein	2.95 (1.8-7.62)	4.20 (3-6.4)	0.35
Number of calcified arteries	1 (0-2)	5 (4-5)	0.001
CCAS	8.5 (0-54)	850 (516-1191)	0.001

Table 2: Comparison between two patients groups No or Moderate calcification with CCAS= 0–400 and Severe calcification with CCAS >400. CCAS: Calcium coronary Agatston score. Non parametric test (Mann-Withney test) was used for comparison of Continuous variabl *Categorical variable were compared by Khi-deux test. The significance level was set at 0.05

The AIVA was the first site of calcification (69.4%) followed by the RCA (36.7%) and the Cx A (30.6%). Calcifications were present simultaneously in two coronary arteries in 66% of cases. The number of calcified arteries increased with age (r=0.396).

Discussion

Vascular calcifications are an important cardiovascular risk factor in MHP [7]. Coronary artery calcifications are highly frequent and extensive disease in MHP population [8-11]. Detection of such calcifications may be helpful in clinical practice [12-14]. Multi Slice Cardio Tomography (MSCT) is a new non-invasive and sensitive image technique for assessment of density and volume of calcification at multiple sites and allows quantitative scoring of vascular calcification using calcium scores [15]. In this study 69.4% of MHP

showed coronary calcifications at the IVA artery. The number of affected coronary arteries increased with age.

High calcium score may be associated with high risk of future adverse coronary events [1]. Several reviews support the predictive value of quantifying coronary artery calcification and the utility of screening for coronary calcification to stratify moderate-high risk individuals for future adverse coronary events [16-18]. However the precise contribution of intimal and medial calcification to the coronary artery calcification score seen on MSCT or Electron Beam Cardio-Tomgraphy among MHP is not well established [16]. Different reports showed correlation between severe coronary calcification score and age, diabetes and higher calcemia among MHP [16-18].

Forty-seven percent of CCAS in this study were classified beyond the 80th percentile rank. This means that only 20% of matched general population could have a CCAS superior to MHP. The CCAS performed by MSCT could add an additional prognostic value to traditional risk factors for coronary artery disease. High percentile ranks CCAS matched for age and sex could be a powerful predictor of myocardial infarction and death.

In conclusion MSCT could be a sensitive and non-invasive method to assess and quantify the progression of coronary artery calcification among MHP [16].

References

1. National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases (2007) U.S. Renal Data System, USRDS 2006 Annual Data Report: Atlas of Chronic Kidney Disease and End-Stage Renal Disease in the United States.

2. Foley RN, Parfrey PS, Sarnak MJ (1998) Clinical epidemiology of cardiovascular disease in chronic renal disease. Am J Kidney Dis 32: S112-119.

3. Thompson GR, Naoumova R, Sidhu P, Underwood R (1994) Predicting coronary heart disease. Lancet 343: 670-671.

4. Iyer H, Abraham G, Reddy YN, Pandurangi UM, Kalaichelvan U, et al. (2013) Risk factors of chronic kidney disease influencing cardiac calcification. Saudi J Kidney Dis Transpl 24: 1189-1194.

5. Miha´ ly K. de Bie, Maurits S. Buiten, Andre´ Gaasbeek, Mark J. Boogers, Cornelis J. Roos, et al. (2013) CT Coronary Angiography Is Feasible for the Assessment of Coronary Artery Disease in Chronic Dialysis Patients, Despite High Average Calcium Scores. PLOS ONE 8: e67936

6. Pilar Caro, Raul Hernandez, Ramon Delgado (2010) Progression of Coronary Artery Calcification Using a Multidetector CT on Hemodialysis Patients in One Year. Dialysis & Transplantation 39: 27-32.

7. Achenbach S, Oshage W, Ropers D, Ossen J, Danie W (1998) Value of electron-beam computed tomography for the noninvasive detection of high-grade coronary-artery stenoses and occlusions. N Engl J Med 339: 1964-1971.

8. Charytan D, Kuntz RE, Mauri L, DeFilippi C (2007) Distribution of coronary artery disease and relation to mortality in asymptomatic hemodialysis patients. Am J Kidney Dis 49: 409-416.

9. Goodman WG, Goldin J, Kuizon BD, Yoon C, Gales B, et al. (2000) Coronary-artery calcification in young adults with end-stage renal disease who are undergoing dialysis. N Engl J Med 342: 1478-1483.

10. Mowatt G, Cook JA, Hillis GS, Walker S, Fraser C, et al. (2008) 64-Slice computed tomography angiography in the diagnosis and assessment of coronary artery disease: systematic review and meta-analysis. Heart 94: 1386-1393.

11. London GM, Guérin AP, Marchais SJ, Métivier F, Pannier B, et al. (2003) Arterial media calcification in end-stage renal disease: impact on all-cause and cardiovascular mortality. Nephrol Dial Transplant 18: 1731-1740.

12. Block GA, Raggi P, Bellasi A, Kooienga L, Spiegel DM (2007) Mortality effect of coronary calcification and phosphate binder choice in incident hemodialysis patients. Kidney Int 71: 438-441.

13. Greenland P, Bonow RO, Brundage BH, Budoff MJ, Eisenberg MJ, et al. (2007) ACCF/AHA 2007 clinical expert consensus document on coronary artery calcium scoring by computed tomography in global cardiovascular risk assessment and in evaluation of patients with chest pain: a report of the American College of Cardiology Foundation Clinical Expert Consensus Task Force (ACCF/AHA Writing Committee to Update the 2000 Expert Consensus Document on Electron Beam Computed Tomography). Circulation 115: 402-426.

14. Fayez Bazeeda, Salah Moselhey, Adel Al Masswary (2011) Value of multislice CT coronary arteries calcification scoring in the prediction of coronary arteries pathology in chronic kidney disease patients. The Egyptian Journal of Radiology and Nuclear Medicine 42: 275-280.

15. Shantouf RS, Budoff MJ, Ahmadi N, Ghaffari A, Flores F, Gopal A, et al. (2010) Total and individual coronary artery calcium scores as independent predictors of mortality in hemodialysis patients. K. Am J Nephrol 31: 419-425.

16. Nitta K, Akiba T, Suzuki K, Uchida K, Ogawa T, et al. (2004) Assessment of Coronary Artery Calcification in Hemodialysis Patients Using Multi-Detector Spiral CT Scan. Hypertens Res 27: 527-533.

17. Levin A (2003) Clinical epidemiology of cardiovascular disease in chronic kidney disease prior to dialysis. Semin Dial 16: 101-105.

18. Goldsmith D, Ritz E, Covic A (2004) Vascular calcification: a stiff challenge for the nephrologist: does preventing bone disease cause arterial disease? Kidney Int 66: 1315-1333.