­Table 1. Associates of vascular calcification

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Author | PMID | Country | Time | CKD stages | sample | Independent variable | Risk | Calcification | Ref |
| Chue CD | 22723973 | UK | 2012 | 3 | 120 | Male gender | +24% compared to no calcification | AAC | (1) |
| Renaud H | 3340252 | France | 1988 | 5D (HD) | 24 | Male gender | Simple covariance coefficient = 1.97, p < 0.01 | Linear calcifications of the abdominal aorta and of the iliac and femoral arteries | (2) |
| Al-Rifai | 22259897 | Lebanon | 2011 | 5D (HD) | 43 | Gender | No association between VC and gender | Hand X-rays | (3) |
| Tangvoraphonkchai K. | 31291619 | USA | 2019 | 5D (PD) | 24 | Male gender (%) | Stable PWV vs. increased PWV: 33% vs. 75% | Pulse wave velocity as surrogate | (4) |
| Jean G | 18852190 | France | 2008 | 5D (HD) | 161 | Male gender | Score 3 vs. score 0: 77% vs. 45% | diffuse VCs with aortic, iliac, femoral, popliteal and arm artery VCs | (5) |
| Disthabanchong S | 29236239 | Thailand | 2018 | 2-5T | 419 | Male gender (%) | AAC > 6 vs. ≤ 6: 44.4 vs. 62.6 (in CKD 2-5) | AAC | (6) |
| Cejka | 24709688 | Austria | 2014 | 5D (HD) | 66 | Male vs. female | Total score: 1535 [789–2281] vs. 514 [117–911], p = 0.01 | CAC score (Agatston) | (7) |
|  |  |  |  |  |  |  | Left main artery: 46 [6–86] vs. 6 [0–15], p = 0.035 |  |  |
|  |  |  |  |  |  |  | Left anterior descending: 630 [333–927] vs. 208 [68–349], p = 0.018 |  |  |
|  |  |  |  |  |  |  | Circumﬂex artery: 193 [2–384] vs. 57 [0–123], p = 0.24 |  |  |
|  |  |  |  |  |  |  | Right coronary artery: 667 [298–1035] vs. 242 [0–519], p = 0.017 |  |  |
|  |  |  |  |  |  | Male vs. female | Men CAC score <100 vs. CAC score ≥100 vs. Women CAC score <100 vs. CAC score ≥100: s289 vs. 241 vs. 228 vs. 189, p =0.03 | Total bone density (Dtot) |  |
|  |  |  |  |  |  |  | Men CAC score <100 vs. CAC score ≥100 vs. Women CAC score <100 vs. CAC score ≥100: 14 12 11 9, p = 0.03 | Bone volume (BV/TV) |  |
| Mazzaferro S | 17259697 | Italy | 2007 | 5D-5T | 100 | Male gender | Male-Dialysis (D) vs. Male-Transplant (Tx) vs. Female-D vs. Female-Tx: 1944 vs. 945 vs. 157 vs. 35, p < 0.02 | CACS (Agatston score) | (8) |
| He J | 22980963 | US (CRIC study) | 2012 | 2-4 | 2018 | Male gender | 0 vs. 0-100 vs. >100: 41.9% vs. 53.3% vs. 63.6%, p < 0.0001 | Total Agatston score | (9) |
| Lioufas NM | 32023606 | Multicenter (IMPROVE-CKD) | 2020 | 3b-4 | 278 | Male gender | 73% vs. 55% compared with no AAC | AAC (Agatston) | (10) |
| Ossareh S | 33277456 | Iran | 2020 | 5D (HD) | 143 | Male gender | 0.76 vs. 0.69, P < .05 | Common carotid intima media thickness (ccIMT) | (11) |
|  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |
| Nigwekar SU | 27080977 | USA | 2016 | 5D (HD) | 3090 | Female gender | Central CUA vs. peripheral CUA: 73% vs. 61% | Calcific Uremic Arteriolopathy (CUA) | (12) |
|  |  |  |  |  |  |  | CUA has a predilection for white, female, diabetic, and obese patients and, especially in these patients, research and clinical attention should focus on avoiding additional CUA triggers such as vitamin K antagonism or deficiency, skin trauma, and mineral bone abnormalities. |  |  |
| Fusaro M | 23927679 | Italy | 2013 | 5D (HD) | 387 | Warfarin-treated male | 77.8 vs. 57.7%, p<0.04 compared to control male | Vertebral fractures | (13) |
|  |  |  |  |  |  |  | Compared with controls, warfarin-treated male patients had more vertebral fractures (77.8 vs. 57.7%, p<0.04), but not females (42.1% vs. 48.4%, p=0.6); |  |  |
|  |  |  |  |  |  |  |  |  |  |
| Ahmed S | 11382698 | USA | 2001 | 5D | 20 | Female gender | Cases vs. control: 90% vs. 49.7% | Calciphylaxis (calcific uremic arteriolopathy) | (14) |
| Charitaki E | 24473732 | UK | 2014 | 5D (HD) | 303 | Female vs. male | Pearson r = -0.124, p = 0.031 | PWV | (15) |
| Kahn *et al* | 27988970 | Austria | 2017 | 5T | 205 | Male gender vs. female | Total iliac: 1.00 (0.25-1.75) vs. 0.50 (0.13-1.13) | Vascular calcification score from native CT scan of the iliac region, containing right and left external iliac artery (REIA and LEIA), common iliac artery (RCIA and LCIA), distal aorta (AO) | (16) |
|  |  |  |  |  |  |  | LCIA: 1.00 (0.50-2.00) 1.00 (0.00-1.88) |  |  |
|  |  |  |  |  |  |  | REIA: 1.00 (0.00-1.50) 0.00 (0.00-0.50) |  |  |
|  |  |  |  |  |  |  | LEIA: 1.00 (0.00-1.50) 0.00 (0.00-0.50) |  |  |
| Ștefan *et al* | 31599199 | Romania | 2019 | 2-4 | 44 | Neutral | Male in RRI > 0.7 vs. RRI ≤ 0.7: 65% vs. 52%, p = 0.4 | Intrarenal resistance index (RRI) obtained from Doppler ultrasonography of interlobar  and arcuate arteries in the upper, middle, and lower  parts of the kidney. | (17) |
|  |  |  |  |  |  |  |  |  |  |
| Alayoud *et al* | 32127198 | France | 2020 | 5D (HD) | 28 | Male progress more | Male in progression vs. no progression: 36.4% (8M/14F) vs. 83.3% (5M/1F), p = 0.02 | Progression of CAC (Agatston score) measured with multi-slice ultra-fast CT | (18) |
| Chen *et al.* | 28329057 | US | 2017 | 1-4 | 1541 | Male more severe | Male in CAC score 0 vs. 0-100 vs. >100: 41.7% vs. 54.3% vs. 65.2%, p < 0.001 | CACS (Agatston score) measured with electron-beam or  multidetector CT | (19) |
| Wang *et al.* | 24876353 | China (Hong Kong) | 2014 | 3-5 | 300 | Male more severe | Male in CACS 0 vs. 1–99 vs. 100–399 vs. ≥400: 57.5% vs. 56.9% vs. 77.3%, p <0.001 | CACS (Agatston score) measured with CT | (20) |
| Etta *et al.* | 28748891 | India | 2017 | 4-5 | 95 | Neutral | Male in absent vs. present of calcification: 67.6% vs. 85.7%, p = 0.08 | Cardiac valvular calcification assessed with echocardiography | (21) |
|  |  |  |  |  |  |  | Male in absent vs. present of calcification: 71.8% vs. 70.0%, p = 0.58 | Abdominal aorta calcification assessed with lateral abdominal radiograph |  |
| Keyzer *et al.* | 25925688 | Netherlands | 2015 | 5T | 699 | Neutral | Male in tertile 1 vs. 2 vs. 3: 58% vs. 55% vs. 57% | Blood calcification propensity measured with Serum T50 | (22) |
| Zhou *et al.* | 30309449 | Sweden | 2018 | 1-5 | 151 | More male had AAC | Male vs. female: 76% vs. 69% | AAC evaluated with lateral lumbar X-ray (Kauppila score) | (23) |
|  |  |  |  |  |  |  | More men (76%) had AAC than women (69%). 沒有p-value |  |  |
| Bae *et al.* | 27709829 | Korea (multicenter) | 2016 | 5D (HD) | 423 | Male more severe | Median CAC score in male: 44.10 (0.00–258.70) vs. 5.15 (0.00–154.05) | CACS measured with L-spine  Radiography (Kauppila score) | (24) |
|  |  |  |  |  |  |  | 同一篇的multivariate沒有顯著差異 |  |  |
| El Amrani *et al.* | 25702239 | Morocco | 2015 | 5D (HD) | 49 | More male with CAC | Male in group with vs. without CAC: 64.7% vs. 26,6 %, p = 0.014 | CACS assessed with CT (Agatston score) | (25) |
|  |  |  |  |  |  | Neutral | Male in group with vs. without valvular calcification: 45.8% vs. 60%, p = 0.321 | Valvular calcification assessed with echocardiography with hyperechoic lesion >1 mm thick was detected on the mitral or aortic valves |  |
| Chou *et al.* | 30594298 | Taiwan | 2018 | 5D | 49 | Neutral | Male in symptomatic secondary hyperparathyroidism compared with in control patients under hemodialysis:  34.7% vs. 38.5%, p = 1.0 | SSHT | (26) |
| DeLoach *et al.* | 19164320 | US | 2009 | 5T | 112 | Neutral | Calcification vs. no calcification: 68.4% vs. 58.1%, p = 0.29 | Aortic calcification measured with electron beam computed tomography (Agatston score) | (27) |
| Arjona Barrionuevo *et al.* | 20970624 | Spain | 2010 | 5T (awaiting transplant) | 356 | Female at risk | A positive correlation was observed between valve calcifications and female sex | Valvular calcification assessed with transthoracic echocardiography | (28) |
| Wu *et al.* | 27497908 | Taiwan | 2017 | 5D (PD) | 190 | Neutral | Grade 0 vs. 1 vs. 2 vs. 3: 43.8% vs. 40.4% vs. 58.3% vs. 37.0%, p = 0.293 | AoAC detected with chest X-ray | (29) |
| Coll *et al.* | 20930091 | Spain | 2010 | 5D | 232 | Male more prevalent with calcification | With vs. without linear calcification: 65% vs 41% | Linear calcification assessed with carotid, femoral, or brachial ultrasound | (30) |
|  |  |  |  |  |  |  | Multivariate就變neutral |  |  |
| Merjanian *et al.* | 12787418 | US | 2003 | Nondialyzed DAD | 32 | Loss of CAC prevalence in male DKD vs. control | Male 92% vs. 67%, p > 0.05  Female 95% vs. 54%, p < 0.05 | CAC measured with electron beam CT (Agatston and volumetric method) | (31) |
|  |  |  |  |  |  | Male prone to increased severity of CAC | Male 619 vs. 18, p < 0.05  Female 232 vs. 6, p < 0.001 | CAC measured with electron beam CT (Agatston and volumetric method) |  |
| Liu *et al.* | 27156072 | China | 2016 | 5D | 41 | Neutral | Male vs. female in non-VC: 59.38% vs. 40.63%  Male vs. female in VC: 66.67% vs. 33.33%  P = 0.993 | VC, the degree of calcium salt deposition assessed with immunohistochemical analysis of radial arteries | (32) |
| London *et al.* | 23343541 | France | 2013 | 5D (HD) | 155 | Neutral | Gender ratio in CCA calcified vs. CCA non-calcified: 1.38±0.48 vs. 1.44±0.49, p > 0.05 | Common carotid artery (CCA) calcification assessed with ultrasonography | (33) |
| Davis *et al.* | 26797375 | US | 2016 | 5T | 131 | Neutral | Regression coefficient estimate of Length score of three readers: 0.051, p = 0.81; -0.070, p = 0.74; -0.16, p = 0.44  Circumference score in three readers: 0.060, p = 0.78; 0.012, p = 0.96; -0.089, p = 0.66  Morphology score in three readers: 0.12, p = 0.46; 0.029, p = 0.86; 0.047, p = 0.71 | Semiquantitative calcification scoring assessed with CT of bilateral common and external iliac arteries | (34) |
| Munguia *et al.* | 26518929 | Spain | 2015 | 5T | 119 | Neutral | Without VC vs. with VC: 62.3% vs. 70%, p = 0.384 | AAC assessed with lateral lumbar radiography of L4-S1 (KauppiIa index) | (35) |
| Bellasi *et al.* | 22630831 | US | 2012 | 5D (HD) | 141 | Neutral | Women in cardiovascular calcification index 0–2 vs. 3–4 vs. 5–7 vs. 8–11: 51% vs. 48% vs. 61% vs. 38%, p = 0.57 | Cardiovascular calcification index assessed with two-dimensional echocardiography | (36) |
|  |  |  |  |  |  |  |  |  |  |

Table 2. Causes of vascular calcification

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Author | PMID | Country | Time | CKD stages | sample | Independent variable | Risk | Calcification | Ref |
| Craver L | 24119158 | Spain | 2013 | 3-4 | 178 | Male sex | All patients: OR 4.218 (1.403-14.207)  eGFR < 30: OR 4.167 (1.050-20.178) | Abdominal aortic calcification (AAC) (Kauppila Index) | (37) |
|  |  |  |  |  |  |  | Lack of a FEP-FGF23 correlation in patients with severe AAC (KI > 5) suggested a role for an impaired phosphaturic response to FGF23 but not to PTH in AAC. Logistic and zero-inflated analysis confirmed the independent association of age, CKD stage, male gender and CP with AAC, and also identified a threshold FEP/FGF23 ratio of 1/3.9, below which the chances for a patient of presenting severe AAC increased by 3-fold. |  |  |
| Kirkpantur A | 19681840 | Turkey | 2009 | 5D (HD) | 102 | Male gender | HR 0.87 (0.56–0.91, p=0.87) | Coronary artery calcification score (CACS) | (38) |
| Pateinakis P | 23758931 | Greece | 2013 | 5D (HD) | 81 | Gender | β = -0.163, p = 0.025 | Common carotid intima-media thickness (ccIMT) | (39) |
|  |  |  |  |  |  | Neutral | β = −0.128, p = 0.150 | Carotid-femoral PWV (cfPWV) |  |
| Golembiewska E | 32033584 | Sweden | 2020 | 5-5D | 149 | Male gender | OR 4.4 (1.6–11.1) | Inferior epigastric artery & CACS | (40) |
|  |  |  |  |  |  |  | Male -x-> copeptin: β = −0.08 (0.31) |  |  |
| Chen Z | 28036114 | Sweden | 2017 | 5D-5T | 240 | Male gender | After adjustments for confounders by GLM (age, gender, BMI, diabetes, inflammation), only age, male gender, diabetes and statins remained significantly related to high CAC score. | CACS | (41) |
|  |  |  |  |  |  |  | Model with hsCRP: estimate = −0.38, se = 0.11, p = 0.005 |  |  |
|  |  |  |  |  |  |  | Model with IL-6: estimate = 0.40, se = 0.13, p = 0.002 |  |  |
|  |  |  |  |  |  |  | Model with TNF but without statins: estimate = 0.35, se = 0.13, p = 0.008 |  |  |
| Gelev S | 19259046 | Republic of Macedonia | 2008 | 5D (HD) | 150 | Male gender | +27% compared to female (80/91 vs. 36/59) | Arterial intimal & media calcification (AIC & AMC) | (42) |
|  |  |  |  |  |  |  | The present results suggest a few emerging risk factors for the occurrence of arterial  calcifications, especially of AIC in our HD patients, such as age older than 55, male gender, diabetes, as well as higher CRP (> 4.5 mg/L), blood leucocytes (> 6.5 × 109L), corrected total serum Ca (> 2.35 mmol/L), serum triglycerides (> 1.8 mmol/L), PP (> 60 mmHg) and BMI (> 23 kg/m2). |  |  |
|  |  |  |  |  |  |  | Our findings of significantly higher percentages of ACA in patients who were younger (under  55 yrs at inclusion and 45 yrs at the start of HD), predominantly female, without diabetes and with higher percentages of K/DOQI guideline recommended levels for serum Ca, are supportive of the previous reports [11, 15, 17]. |  |  |
| Capusa C |  | Romania | 2012 | 3-5 | 106 | Male gender | T ratio = 2.15, p = 0.04 | Aortic calcification score (ACS) | (43) |
| Maharem DA |  | Egypt | 2013 | 5-5T | 73 | Male gender |  | SVCS | (44) |
|  |  |  |  |  |  |  | VC was significantly associated with older age, male gender, longer HD duration, lower albumin, higher LDL-c, higher carotid plaques and lower BMD at the lumbar spine and the T-score value but had no significant association with the following parameters: duration of transplantation, blood pressure, total cholesterol, TG, Ca, PO4, Ca·PO4, iPTH, CRP, fetuin A, e-GFR and IMT. Also no significant association was seen between fetuin-A gene polymorphism and VC. Patients with VC had higher CRP than those without but did not reach a significant value. (Table 10). |  |  |
|  |  |  |  |  |  |  | P = 0.056 不應該相關，但是內文說相關 |  |  |
| Schlieper G |  | Germany? | 2015 | 5D (HD) | 220 | Gender? | HR 0.50 (0.28-0.87) | Adragao calcification scores | (45) |
|  |  |  |  |  |  |  |  |  |  |
| Schlieper G | 19468238 | Serbia | 2009 |  |  | Male gender | 2.75 (1.41–5.38) | Adragao calcification score | (46) |
|  |  |  |  |  |  |  | 2.32 (1.19–4.52) | Composite score |  |
| Sigrist M | 16263735 | UK | 2005 | 4-5D | 134 | Male gender | Calcification tertile 1/2/3: 18 (46%) / 28 (71%) / 39 (81%), P<0.001 | Multi-slice spiral CT scanning of a 5 cm standardized  segment of superficial femoral artery | (47) |
| Harada PHN | 25479288 | Brazil | 2014 | 2-5 | 117 | Male gender | OR 4.92 (2.07–11.70) | CACS | (48) |
|  |  |  |  |  |  | Pericardial fat | OR 1.85 (1.00-3.42) |  |  |
| Okamoto T | 29558928 | Japan | 2018 | 5D (HD) | 184 | Male gender | OR 3.29 (1.27–8.53) | Abdominal aortic calcification index | (49) |
| Vipattawat K | 24447254 | Thailand | 2014 | 5-5T | 261 | Male gender | Kidney transplant, univariate: OR 2.36 (1.13–4.91), p = 0.02\* | Total vascular calcification score | (50) |
|  |  |  |  |  |  |  | Kidney transplant, multivariate: OR 2.49 (0.87–7.14), p = 0.09 |  |  |
|  |  |  |  |  |  |  | CKD 5-5D, univariate: 1.44 (0.71–2.91), p = 0.32 |  |  |
|  |  |  |  |  |  |  | CKD 5-5D, multivariate: 2.02 (0.71–5.78), p = 0.19 |  |  |
| Evenpoel P | 26505822 | Belgium | 2015 | 5T | 268 | Male gender (F 1) | β = -0.64, t = 5.6, p = 0.0001 | Baseline CACS | (51) |
|  |  |  |  |  |  |  | β = -0.32, t = 2.3, p = 0.008 | Baseline aortic calcification |  |
|  |  |  |  |  |  | Male gender | P = 0.002 | Sclerostin |  |
|  |  |  |  |  |  |  | In multivariate regression analysis, higher age (P =.0001), **male gender (P =.002)**, lower eGFR (P =.002), lower PTH (P =.0001) and lower calcitriol levels (P =.05) were identified as independent determinants of higher levels of circulating **sclerostin**. |  |  |
| Jansson H | 31437840 | Sweden | 2019 | 3-4 | 84 | Male gender | β = 0.413, p = 0.030 | AAC volume | (52) |
| Nitta K | 30347400 | Japan | 2018 | 5D (HD) | 216 | Male gender | β = 0.221, 95%CI 0.124–0.319, p <0.0001 | AoAC score | (53) |
| Nishizawa Y | 15648030 | Japan | 2004 | 5D (HD) | 332 | Male gender | OR 3.380 (1.289-8.860) | Vascular calcification | (54) |
| Chiu Y-W | 20237457 | USA | 2010 | 1-5 | 225 | Male gender | Using multivariate linear regression analysis, increasing age  (P = 0.001), male gender (P = 0.01), and non-Latino whites (P = 0.003) were independently associated with a higher log-  transformed baseline CAC score. | CAC | (55) |
|  |  |  |  |  |  |  | 沒有列詳細數據 |  |  |
| Jankovic A | 28124305 | Serbia | 2017 | 5D (HD) | 90 | Female gender | OR 0.134 (0.04–0.45) | calcification in arteriovenous fistula (AVF)-blood vessels | (56) |
| Komatsu M | 25571879 | Japan | 2014 | 5D (HD) | 301 | Male gender (%) | Grade 0 vs. 1 vs. 2+3: 98/126 vs. 63/112 vs. 37/63, p = 0.0009 | AoAC | (57) |
| Jankovic A | 25823466 | Serbia | 2015 | 5D (HD) | 90 | Male gender | β = –0.432, p < 0.001 | overall calcification  score | (58) |
| Ishimura E | 12378387 | Japan | 2002 | 5D (HD) | 421 | Male gender | OR 3.380 (1.289-8.860) | Vascular calcification | (59) |
|  |  |  |  |  |  |  | 重複 |  |  |
| Turan MN | 26865177 | Turkey | 2016 | 5D (HD) | 224 | Male gender | RR 4.14 (2.01–8.51) | CACS | (60) |
| Claes KJ | 22143191 | Belgium | 2013 | 5T | 115 | Male gender (%) | PWV ≤ 7.35 m/s vs. > 7.35 m/s: 74 vs. 56, p = 0.05 | PWV | (61) |
| Manghat P | 21281749 | UK | 2011 | 1-4 | 145 | Male gender | β = 0.29, t =2.04, p =0.049 | Arterial Stiffness (SIDVP) | (62) |
| Qureshi AR | 26331407 | Sweden | 2015 | 5T | 89 | Male gender | RR 1.82 (1.03–1.16) | Vascular calcification | (63) |
| Jean G | 26890570 | France | 2016 | 5D (HD) | 227 | Female gender | OR 0.16 (0.075−0.362) | Serum sclerostin level | (64) |
| Sumida Y | 20420796 | Japan | 2010 |  |  | Male gender | Male gender was identified as an independent determinant for CAP. | Coronary artery plaque (CAP) | (65) |
| Raggi P | 11849871 | Multicenter (USA & Europe) | 2002 | 5D (HD) | 205 | Female gender | Parameter estimate = -0.587547, p = 0.0167 | Coronary artery calcification | (66) |
| Nishiura R | 18802328 | Japan | 2009 | 5D (HD) | 99 | Male gender | HR 3.034 (1.028–8.948) | OPG level | (67) |
| Beddhu S | 20630128 | HEMO Study | 2010 | 5D (HD) | 1827 | Male gender | The lower serum alkaline phosphatase group was associated with older age, **male gender**, non-black race and shorter dialysis years as well as higher serum calcium, higher serum calcium-phosphorus product and lower parathyroid hormone levels. | Lower alkaline phosphate | (68) |
|  |  |  |  |  |  |  | Alkaline phosphatase is typically considered as an innocent by-stander, but emerging data suggest that alkaline phosphatase might play a pathogenic role in vascular calcification and thus contribute to increased mortality in hemodialysis patients. |  |  |
| Mazzaferro S | 17259697 | Italy | 2007 | 5D-5T | 100 | Male gender | OR 10.5 (3.2–34.4) | CACS (Agatston) | (8) |
| Shu K-H | 22483469 | Taiwan | 2012 | 5T | 99 | Female gender | β = -1.61, p = 0.0021 | CACS | (69) |
| Schlieper G | 18800030 | Serbia | 2008 | 5D (HD) | 212 | Male gender | OR 5.08 (2.18–11.86) | Vascular access calcification | (70) |
| Morena M | 19574342 | France | 2009 | 1-5 | 133 | Male gender | OR 4.95 (2.36–10.37) | CACS ≥ 100 | (71) |
| Bellasi A | 17524408 | USA | 2008 | 5D | 142 | Male gender | Estimate = 735.82, p = 0.0366 | CACS (R-square 0.37) | (72) |
|  |  |  |  |  |  |  |  |  |  |
| Oprisiu R | 11774125 | France | 2002 | 5D (HD) | 24 | Male gender | Indeed, this observation is reminiscent of our own observation regarding the **extension of calcification** assessed prospectively on 3 years in 24 hemodialysis patients who never received vitamin D derivatives. The calcifications were measured on lateral and frontal X rays of lumbar spine and pelvis at the level of aorta, iliac, and femoral arteries.' This extension was exponential, and simple covariance analysis showed that the main significant risk factors for extension were **male gender**, age (only in male patients) | Extension of calcification | (73) |
| Evenpoel P | 26505822 | Belgium | 2015 | 5T | 268 | Male gender | β = -0.45, t = 4.01, p = 0.0001 | Annualized CACS change | (51) |
| Sigrist MK | 17928470 | UK | 2007 | 4-5D | 134 | Male gender | OR 8.82 (1.82 to 42.65) | Vascular calcification progression during 24 months | (74) |
| Tamei N | 21139318 | Japan | 2011 | 5D (HD) | 127 | Male gender | F-value = 5.092, β = 0.969, p = 0.0192 | AoACS progression (5 years) | (75) |
| Jung HH | 16554319 | Republic of Korea | 2006 | 5D (HD) | 40 | Male gender | B = 1.365, SE = 0.639, β = 0.317, p = 0.040 | annualized change of square root-transformed CAC  score | (76) |
| Scialla JJ | 21940840 | USA | 2011 | 1-5 | 351 | Female gender | Female -> Osteoprotegerin: 10.2% (0.2%– 21.3%) | OPG (percentage difference) | (77) |
| Kanbay M | 20576822 | Turkey | 2010 | 2-3 | 177 | Male gender | R = -0.181, p = 0.016 | Gensini score | (78) |
|  |  |  |  |  |  |  | The Gensini score values significantly correlated in univariate analysis with gender (R = -0.181, P = 0.016), presence of hyperension (R = 0.203, P = 0.007), HDL cholesterol level (R = -0.158, P = 0.047), eGFR (R = -0.315, P 0.001), iPTH (R = 0.152; P = 0.044), FGF 23 (R = 0.868; P = 0.001), and fetuin A levels (R = 0.491; P = 0.001) but not with the vitamin D values. |  |  |
| Jean G | 18721733 | France | 2008 | 5D (HD) | 253 | Female gender | Vitamin D (25D) deficient vs. sufficient: 53% vs. 28%, p < 0.05 | Vitamin D (25D) deficiency | (79) |
|  |  |  |  |  |  |  | Vitamin D deficiency was reported to be  associated with cardiovascular calcification, 5 |  |  |
| Hou J-S | 31122190 | Taiwan | 2019 | 5D (HD) | 120 | Female gender | OPG tertile 1/2/3: 62.5% / 55.0% / 32.%, p = 0.008\* | OPG | (80) |
|  |  |  |  |  |  |  | Bone loss -> OPG -> calcification |  |  |
| Flávia Letícia Carvalho Gonçalves | 25465028 | Brazil | 2014 | 5D (HD) | 91 | Gender (M/F) | Low vs High sclerostin: 24/22 vs. 31/14, p = 0.103 | Sclerostin | (81) |
| Chang JH | 22169112 | Republic of Korea | 2012 | 5D (HD) | 289 | Female gender | OR 3.892 (1.678–9.025) | Vitamin D (25D) deficiency | (82) |
| Zhang AH | 31079116 | China | 2019 | 5D (HD) | 105 | Male gender (male = 1, female = 2) | Correlation coefficient = -0.211, p = 0.03 | Interventricular septal thickness (IVST) | (83) |
|  |  |  |  |  |  |  | Lower A-Klotho -> higher IVST; Female thinner IVST |  |  |
| Block GA | 9531176 | USA | 1998 | 5D (HD) | 6407 | Male gender | OR 0.774, p = 0.0001 | Serum phosphorus > 6.5 mg/dL | (84) |
|  |  |  |  |  |  |  | Female -> higher serum phosphorus |  |  |
| Ho TY | 31477034 | Taiwan | 2019 | 5D | 61 | Male gender (female = 0, male = 1) | B = 1688.01, SE = 681.54,t = 2.48, p = 0.02 | CAC (Agatston) | (85) |
| Kuo TH | 31315601 | Taiwan | 2019 | 5D (PD) | 89 | Male gender | OR 2.882 (1.219–6.815) | above-median sclerostin levels | (86) |
| Fain ME | 29635270 | USA | 2018 | 5D (HD) | 37 | Male gender | Β ± SE = 2.23 ± 0.78, R2 = 0.090 | Carotid-femoral PWV | (87) |
|  |  |  |  |  |  |  | B ± SE = 4.16 ± 1.65, R2 = 0.121 | brachial artery flow-mediated dilation (FMD) |  |
| Claes KJ | 23788689 | Belgium | 2013 | 1-5 | 154 | Male gender | In multivariate regression analysis, older  age (P < .0001), male sex (P = .006), lower eGFR ( P =  .0008), the absence of calcification (P = .006), lower bsAP  levels (P = .03), and lower cholesterol levels (P = .03) were  identified as independent determinants of higher levels of  circulating sclerostin. | Circulating sclerostin | (88) |
| Baralić M | 30867641 | Serbia | 2018 | 5D (HD) | 56 | Sex (0? 1?) | B = -12.740, 95% CI = -23.967– -1.513, β = -0.273 | Index of left ventricular mass (iLVM) | (89) |
|  |  |  |  |  |  |  | B = -47.88, 95% CI = -95.3– -0.464, β = -0.296 | Relative wall thickness (RWT) |  |
| Porter CJ | 17617653 | UK | 2007 | 3-4 | 112 | Male gender | OR 43.713 (2.92–654.0) | CAC | (90) |
| Kanbay M | 22130958 | Turkey | 2011 | 2-3 | 88 | Male gender | In univariate analysis, the Gensini CAD  severity score correlated significantly with **male**  **gender**, eGFR, and serum levels of 25-OH-vitamin D,  iPTH, FGF-23, fetuin A, and calcitonin (R = 0.474,  P = 0.001 for the latter). | Gensini score | (91) |
| Fusaro M | 24897402 | Italy | 2014 | 5D (HD) | 387 | Male gender | OR 1.86 (CI 1.20–2.91) | Spine deformity index (SDI) > 1 | (92) |
| Nemeth ZK | 26459001 | Hungary | 2015 | 5T | 993 | Gender | B = −3.968, 95%CI −6.006– −1.930, β = −0.116, p < 0.001 | Pulse pressure | (93) |
| Chen HY | 23419133 | Taiwan | 2013 | 5D (HD) | 238 | Male gender | HR 0.92 (0.8–0.98) | Fetuin-A | (94) |
|  |  |  |  |  |  | Female gender | HR 0.87 (0.74–0.92) |  |  |
| Nitta K | 30347400 | Japan | 2018 | 5D (HD) | 389 | Female gender | β = 0.221, 95%CI 0.124–0.319, p < 0.0001 | AoAC | (53) |
| Floege J | 20110249 | Multicenter | 2010 | 5D (HD) | 360 | Male gender | Parameter estimate = 0.42599, SE = 0.42599, p = 0.0011 | CAC | (95) |
|  |  |  |  |  |  |  | Using multivariate analysis, factors shown to predict  CAC in the current study included older age, male gender,  longer dialysis vintage and diabetes, results consistent with  those reported previously. |  |  |
| González-Parra E | 26298279 | Spain | 2015 | 1-5? | 704 | Male gender | r = −0.084, 95% CI -0.155– -0.012, p = 0.0215 | Parathormone levels | (96) |
|  |  |  |  | 不確定是不是CKD cohort |  |  | r = −0.191, 95% CI -0.301– -0.080, p = 0.0007 | FGF-23 |  |
| Nakayama K | 24379691 | Japan | 2013 | 5D (HD) | 47 | Sex (male:0, female:1) | β = -0.41, t = -2.688, p = 0.014 in model with ΔP | Aortic calcification area index (ACAI) | (97) |
|  |  |  |  |  |  |  | β = -0.407, t = -2.608, p = 0.017 in model with ΔCa × P |  |  |
| Dai *et al* | 31823455 | Sweden | 2020 | 5 | 152 | Sex, male versus female | OR 6.67 (2.53–17.58) | coronary artery  calcification (CAC) score by computed tomography (CT) | (98) |
| Ramalho *et al* | 31368056 | Brazil | 2019 | 3-4 | 356 | Neutral | B = 0.10, 95% CI = -0.15–0.35, p = 0.45 | Urinary calcium excretions (UCE) | (99) |
| Bundy *et al* | 30935773 | USA | 2019 | 2-4 | 1274 | Neutral | Female sex in Quartiles 4 vs. 3 vs. 2 vs. 1 of T50: 46% vs. 45% vs. 49% vs. 47% | Serum calcification propensity quantified as transformation time | (100) |
| Wang *et al* | 30989586 | China | 2019 | 5D (HD) | 108 | Neutral | Female gender OR 0.56 (0.15–2.06), p = 0.38 | Severe AAC measured by abdomen lateral plain radiograph | (101) |
| Solbu *et al.* | 27798199 | Multicenter | 2016 | 5D (HD) | 2773 | Male at risk | HR 1.49 (1.21–1.83) | Atherosclerotic events including the first event of the following: non-fatal myocardial infarction, fatal coronary heart disease, non-fatal and fatal non-hemorrhagic stroke, coronary revascularization procedures and death from ischemic limb disease | (102) |
| Tanaka *et al.* | 20851632 | Japan | 2012 | 1-4 | 1198 | Neutral | OR 0.91, p = 0.72 | Carotid calcified plaque | (103) |
| Maia *et al.* | 29880286 | Brazil | 2018 | 5D (HD) | 309 | Female more prevalent | Prevalence ratio 2.004 (1.012 –3.966) | CAC assessed with panoramic radiographs | (104) |
| Chae *et al.* | 30595681 | Korea | 2018 | 1-5 | 1832 | Female milder | Female in quartile 1 vs. 2 vs. 3 vs. 4: 44.3% vs. 41.3% vs. 37.0% vs. 38.1%, p = 0.101, p for trend = 0.025 | Brachial ankle PWV (baPWV) | (105) |
|  |  |  |  |  |  |  | P = 0.101但是p for trend = 0.025 |  |  |
| Kestenbaum *et al.* | 19692998 | US (MESA study) | 2009 | 3-5 | 562 | Male gender at risk | IRR 2.27 (1.26–4.09) | CACS measured with electron beam CT or  multidetector row helical CT | (106) |
|  |  |  |  |  |  | Neutral | IRR 1.10 (0.84–1.42), p = 0.50 | Progression of CAC |  |
| Maréchal *et al.* | 21944666 | Belgium | 2012 | 5T | 197 | Women less at risk | Annualized progression of CACS: regression coefficient = -0.09, SE = 0.04, 95%CI -0.17– -0.01, p = 0.03 | CACS (Agatston score) | (107) |
| Abd Alamir *et al.* | 26188533 | US | 2015 | 2-3 | 2070 | Neutral | OR 1.21 (0.94–1.56) | Mitral annular calcification (MAC) assessed with coronary calcium scanning (Agatston score) | (108) |
| Moldovan *et al.* | 20862543 | Romania | 2010 | 5D (HD) | 81 | Male gender at risk of progression | OR 7.226 (1.138–45.882) | Vascular calcification on hands and pelvis bone radiographs | (109) |
| Sharma *et al.* | 16647710 | UK | 2007 | 5 (for renal transplant evaluation) | 140 | Neutral | OR 0.45 (0.16–0.81), p = 0.53 | MAC assessed with echocardiography | (110) |
| Gross *et al.* | 17699396 | German | 2006 | 3-5, 5D | 23 | Neutral | Media thickness β = 0.068, 95% CI 0.009 to 0.071, p = 0.666  Intima thickness β = 0.041, 95% CI 0.303 to 0.233, p = 0.792  Media area β = 0.084, 95% CI 0.609 to 0.346, p = 0.581  Intima area β = 0.1, 95% CI 0.609 to 0.346, p = 0.524  Plaque area β = 0.075, 95% CI 0.216 to 0.37, p = 0.598  Lumen area β = 0.035, 95% CI 1.437 to 1.827, p = 0.811  Lumen area/lumen + intima β = 0.055, 95% CI 0.077 to 0.111, p = 0.715  CRP intima β = 0.019, 95% CI 0.299 to 0.265, p = 0.904  CRP media β = 0.127, 95% CI 0.275 to 0.108, p = 0.385  PTX3 intima β = 0.417, 95% CI 0.441 to -0.085, p = 0.005  PTX3 media β = 0.0, 95% CI 0.175 to 0.175, p = 1  Fetuin A intima β = 0.122, 95% CI 0.691 to 0.291, p = 0.416  Fetuin A media β = 0.171, 95% CI 0.770 to 0.203, p = 0.246  HIF-1 intima β = 0.091, 95% CI 0.411 to 0.218, p = 0.541  HIF-1 media β = 0.035, 95% CI 0.23 to 0.291, p = 0.814  C5b-9 intima β = 0.004, 95% CI 0.605 to 0.622, p = 0.978  C5b-9 media β = 0.09, 95% CI 0.31 to 0.558, p = 0.567  Collagen IV intima β = 0.195, 95% CI 0.36 to 0.081, p = 0.208  Collagen IV media β = 0.044, 95% CI 0.221 to 0.167, p = 0.78  TGF-β intima β = 0.007, 95% CI 0.215 to 0.225, p = 0.963  TGF-β media β = 0.011, 95% CI 0.25 to 0.233, p = 0.943  ET-1 intima β = 0.033, 95% CI 0.254 to 0.204, p = 0.829  ET-1 media β = 0.012, 95% CI 0.265 to 0.286, p = 0.937  vWF intima β = 0.051, 95% CI 0.367 to 0.52, p = 0.729  vWF media β = 0.034, 95% CI 0.492 to 0.392, p = 0.822  eNOS intima β = 0.039, 95% CI 0.136 to 0.104, p = 0.789  eNOS media β = 0.09, 95% CI 0.193 to 0.105, p = 0.556  Glycophorin A intima β = 0.083, 95% CI 1.852 to 1.054, p = 0.582  CD68 intima β = 0.148, 95% CI 0.909 to 2.518, p = 0.349  CD68 media β = 0.046, 95% CI 7.923 to 5.835, p = 0.761  Intima calcium β = 0.033, 95% CI 5.526 to 6.727, p = 0.844  Intima phosphorus β = 0.057, 95% CI 2.774 to 3.918, p = 0.731  Media calcium β = 0.215, 95% CI 9.173 to 1.793, p = 0.181  Media phosphorus β = 0.118, 95% CI 2.185 to 1.046, p = 0.479  CRP in situ hybridization intima β = 0.184, 95% CI 0.246 to 1.049, p = 0.216  CRP in situ hybridization media β = 0.072, 95% CI 0.246 to 1.049, p = 0.630 | Coronary calcification parameters | (111) |
| Coll *et al.* | 20930091 | Spain | 2010 | 5D | 232 | Neutral | OR 1.57 (0.69–3.55), p = 0.27 | Linear calcification assessed with carotid, femoral, or brachial ultrasound | (30) |
| Gruppen *et al.* | 12631088 | Dutch | 2003 | 5D | 140 | Male gender at risk | β = 0.21, p = 0.009 | LVMI | (112) |
|  |  |  |  |  |  | Neutral | β = 0.17, p = 0.05 | Aortic valve calcification |  |
| Adragao *et al.* | 15034154 | Portugal | 2004 | 5D (HD) | 123 | Male gender at risk | Vascular calcification score ≥ 3: OR 7.47 (2.9–19.1) | Simple vascular calcification score based on plain  radiographic films of pelvis and hands (Adragao) | (113) |
|  |  |  |  |  |  |  | Iliac score > 0: OR 3.5 (1.5–8.3) |  |  |
| Turan *et al.* | 23159099 | Turkey | 2013 | 5D (HD) | 191 | Male gender at risk | RR 2.79 (1.30–5.98) | CAC score assessed with calcification score measured with computed tomography of the left main, the left anterior descending, the left circumflex and the right coronary artery | (114) |
| Zou *et al.* | 27400310 | China | 2016 | 1-5 (pre-dialysis) | 296 | Male at risk | β = 9.21, SE = 3.61, p = 0.01 | LVMI (g/m2) | (115) |
|  |  |  |  | Supplemental table看不到 |  |  |  |  |  |
| Blacher *et al.* | 9555858 | France | 1998 | 5D (HD) | 74 | Male at risk (male = 1, female = 2) | β = -0.25, p = 0.0074 | LV mass calculated according to the Penn convention | (116) |

Table 3. Modifiers of vascular calcification

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Author | PMID | Country | Time | CKD stages | sample | Independent variable | Risk | Calcification | Ref |
| Kirkpantur A | 19681840 | Turkey | 2009 | 5D (HD) | 102 | HD vintage | HR 0.85 (0.58–0.95)  Independent of other influencing factors, HD vintage and serum PTH levels were significant determinants of low bone mass and T-scores in all anatomical sites whereas fetuin-A was an independent predictor in proximal radius, femoral neck, and trochanter | CACS | (38) |
|  |  |  |  |  |  | Serum PTH | Standard regression coefficient -0.21– -0.33 | Bone mineral densities (BMD) |  |
|  |  |  |  |  |  | Fetuin-A | Standard regression coefficient -0.29– -0.41 | BMD |  |
| Kahn J | 27988970 | Austria | 2017 | 5T | 205 | Older than 55 yrs | 1.25 (0.50-2.00) vs. 0.50 (0.00-1.16) | Total iliac calcification (without distal aortic segment) | (16) |
|  |  |  |  |  |  |  | Median total calcification score was 3 (2.2-3) in the patients declined for renal  transplantation, with similar results in the different regions of the iliac arteries. |  |  |
| Golembiewska E | 32033584 | Sweden | 2020 | 5-5D | 149 | Copeptin (1-SD increase) | OR 1.6 (1.1–2.6) | Inferior epigastric artery & CACS | (40) |
|  |  |  |  |  |  |  | Mechanisms of vascular calcification in CKD. In the setting of uraemic milieu, activation of renin-angiotensin and vasopressin systems,  upregulation of sodium-dependent phosphate transporter Pit-1 promotes osteochondrocytic transformation and apoptosis of vascular smooth muscle cell (VSMC) and, in consequence, accelerated vascular calcification |  |  |
|  |  |  |  |  |  | Higher Age (1-SD increase) | OR 2.5 (1.5–4.1) |  |  |
|  |  |  |  |  |  | Diabetes | OR 23.2 (2.5–210.5) |  |  |
| Chen Z | 28036114 | Sweden | 2017 | 5D-5T | 240 | Statins | Model with hsCRP: estimate = 0.29, se = 0.11, p = 0.009 | CACS | (41) |
|  |  |  |  |  |  |  | Model with IL-6: estimate = 0.44, se = 0.14, p = 0.001 |  |  |
| Scialla JJ | 21940840 | USA | 2011 | 1-5 | 351 | Osteoprotegerin (OPG) | Reference | Ratio of aortic pulse wave velocity | (77) |
|  |  |  |  |  |  |  | Tertile 2 (5.05 to 7.45 pmol/L): 1.06 (0.97– 1.15) |  |  |
|  |  |  |  |  |  |  | Tertile 3 (7.46 to 22.31 pmol/L): 1.10 (1.01– 1.20) |  |  |
| Chen Z | 30777028 | Sweden | 2019 | 5 | 174 | Total body bone mineral density (tBMD) in female | β = −0.27, se = 0.12, p = 0.03 | CACS | (117) |
|  |  |  |  |  |  | BMD at legs in female | β = −0.28, se = 0.12, p = 0.02 |  |  |
|  |  |  |  |  |  |  | Multivariate generalized linear model  (GLM) analysis adjusted for age, diabetes and hsCRP showed that in females per SD higher CAC score (1057 AUs) was  predicted by either per SD (0.13 g/cm2) lower tBMD or per SD (0.17 g/cm2) lower BMD at legs. **No such associations were found in male** **ESRD patients**. |  |  |
| Evenpoel P | 26505822 | Belgium | 2015 | 5T | 268 | Lower Sclerostin | Remarkably, **a lower circulating sclerostin** **level** was identified as independent determinant of a higher baseline AoC score in the final regression model, ie, **after adjustment** for traditional (older age, male gender, high BMI, presence of  diabetes, hypertension) and nontraditional (inflammation, high PTH, low calcidiol, long dialysis vintage) risk factors | baseline aortic calcification score | (51) |
| Turan MN | 26865177 | Turkey | 2016 | 5D (HD) | 224 | FGF-23 (per 50 pg/ml) | RR 1.17 (1.05–1.30) | CACS | (60) |
| Qureshi AR | 26331407 | Sweden | 2015 | 5T | 89 | Sclerostin | middle+high sclerostin tertiles vs. low sclerostin tertile: RR 3.67 (1.23–11.02) | Vascular calcification | (63) |
| Morena M | 19574342 | France | 2009 | 1-5 | 133 | Osteoprotegerin | 769.26–1063.62 pg/mL: OR 7.57 (2.06–27.85) | CACS ≥ 100 | (71) |
|  |  |  |  |  |  |  | ≥1063.62 pg/mL: OR 8.54 (2.14–34.11) |  |  |
|  |  |  |  |  |  |  | ROC -> cutoff 757.7 pg/mL |  |  |
| Chen Z | 28036114 | Sweden | 2017 | 5D-5T | 240 | Statins | 0 (0-531) AUs to 273 (0-1256) AUs after 1.5 years of RRT | CACS | (41) |
| Chang JH | 22169112 | Republic of Korea | 2012 | 5D (HD) | 289 | 25D level | r = −0.170, P = 0.004 | Vascular calcification score (Kauppila index) | (82) |
|  |  |  |  |  |  |  | 25D serum levels and VCS (r = −0.170, P = 0.004) at the end of the summer, but not at the end of the winter (r = −0.114, P = 0.054; Fig. 2). Therefore, we analyzed the data to reveal the association of serum 25D level with vascular calciﬁcation at the end of the summer, when vitamin D levels were found to peak. |  |  |
| Sumida Y | 20420796 | Japan | 2010 | 5D (HD) | 135 | Carotid artery plaque | OR 13.89 (4.08 – 47.29) | Carotid artery calcification | (65) |
| Peyro-Shabani A | 30510649 | Iran | 2018 | 5D (HD) | 84 | Female gender | ACI score 0-40 vs. 41-80 vs. 81-120: 3.48±1.18 vs. 4.54±0.93 vs. 3.80±1.04, p = 0.01 | P (mg/dL)(mean ± SD) | (118) |
|  |  |  |  |  |  | Male gender | ACI score 0-40 vs. 41-80 vs. 81-120: 298(68-2630) vs. 287(166-892) vs. 540(391-698), p = 0.02 | Alkaline phosphate (U/L)(median (min-max)) |  |
| Wang *et al.* | 24876353 | China (Hong Kong) | 2014 | 3-5 | 300 | Male gender negatively correlated | Partial correlation coefficient = -0.14, p = 0.02 | Tissue advanced glycation end products (reflected by skin autofluorescence) | (20) |
| Chae *et al.* | 30595681 | Korea | 2018 | 1-5 | 1832 | Neutral | Female in quartile 1 vs. 2 vs. 3 vs. 4 of serum OPG: 36.2 vs. 43.4 vs. 42.5 vs. 38.6, p for trend = 0.517 | Serum OPG | (105) |
| Barreto *et al.* | 19443628 | France | 2009 | 2-5D | 140 | Neutral | Male in 25D ≤ 16.7 ng/ml vs. 25D ≥ 16.7 ng/ml: 59% vs. 62%, p = 0.702 | 25D | (119) |
| Zhang *et al* | 31079116 | China | 2019 | 5D (HD) | 105 | Neutral | Male in ≤25th vs. 25-50th vs. 50-75th vs. ≥75th percentile: 57.7% vs.48.1% vs. 46.2% vs. 65.4%, p = 0.473 | Serum s-Klotho level | (83) |
| Gupta V | 33606319 | Hungary | 2021 | 5D (HD) | 982 | Male gender | Low (<3.20) vs. Med (3.20–4.39) vs. High (>4.39): 63% vs. 57% vs. 52% | OPG tertiles (pmol/L) | (120) |
| Nemeth ZK | 26459001 | Hungary | 2015 | 5T | 993 | Male gender (%) | 1st (<3.20) vs. 2nd (3.20–4.39) vs. 3rd (>4.39): 63% vs. 58% vs. 52%, p = 0.02 | Serum OPG tertiles (pmol/L) | (93) |
| Buiten MS | 25495997 | Netherlands | 2014 | 5D | 127 | Female gender | <460 pg/mL vs. >460 pg/mL: 16% vs 31%, p < 0.05 | Klotho | (121) |
| Riphagen *et al.* | 29292751 | Netherlands | 2017 | Not CKD | 4275 | Male gender | <275 vs. 275–479 vs. ≥480: 40.0% vs. 46.9% vs. 51.0% | dp-ucMGP (/pmol/L) | (122) |
|  |  |  |  |  |  |  | Not CKD |  |  |
| Zou *et al.* | 27400310 | China | 2016 | 1-5 (pre-dialysis) | 296 | Neutral | Serum phosphorus tertile 1 vs. 2 vs. 3: 60.2% vs. 50.0% vs. 61.2%, p = 0.21 | Serum phosphorus | (115) |
| Zhou *et al.* | 28455660 | China | 2017 | 5 | 32 | Neutral | OR 0.750 (0.184–3.057), p = 0.688 | Vessel sclerostin | (123) |
| Holden *et al.* | 24855061 | Canada | 2014 | 3-5 | 167 | Neutral | Male in VKORC1 CC vs. CG/GG: 68% vs. 55%, p = 0.11 | VKORC1 (vitamin K epoxide reductase complex 1) | (124) |
|  |  |  |  |  |  |  | mutation into CC/CG increases the risk of vascular calcification |  |  |
|  |  |  |  |  |  |  |  |  |  |

Table 4. Adjusted risk of complications of vascular calcification or gender difference

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Ref | Time | doi | PMID | Country | Relation | Variable |  | Gender | Calcification | Complications | CKD stages | sample |
| (125) | 2017 | 10.1186/s12882-017-0480-2 | 28253835 | Netherlands | complications | AAC score | OR 1.19 (1.07–1.30) | v | AAC | Coronary artery disease | 5D | 90 |
|  |  |  |  |  |  | Male gender | Univariate: 2.59 (1.00–6.68)  Multivariate: 2.73 (0.95–7.82) |  |  |  |  |  |
| **(1)** | 2012 | 10.1371/journal.pone.0039241 | 22723973 | UK | complications | Male gender (Μ = 0, F = 1) | Β = -0.34 (-13.45– -4.48) | v | AAC | Left ventricular mass index | 3 | 120 |
|  |  |  |  |  |  | Mean femoral Z-score | B = -0.23 (-4.75– -0.85) |  |  |  |  |  |
| (126) | 2021 | 10.1186/s12882-021-02251-y | 33541279 | Finland | complications | Male gender | B = 31.0 | v |  | Maximal ergometry workload (WMAX) | 4-5 | 174 |
|  |  |  |  |  |  | AAC score | B = -1.44 |  | AAC | WMAX% < 50% |  |  |
|  |  |  |  |  |  |  | AAC and TnT showed fair predictive power for WMAX% less than 50% of the expected value with AUCs of 0.70 and 0.75, respectively. |  |  |  |  |  |
| (127) | 2014 | 10.1159/000360230 | 24847332 | Taiwan | complications | Male gender | HR 2.354 (1.371 – 4.042) | v | AAC | Cardiovascular mortality | 5D (HD) | 712 |
|  |  |  |  |  |  | AAC Grade 3 | HR 2.497 (1.237 – 5.043) |  |  | Cardiovascular mortality |  |  |
|  |  |  |  |  |  |  | HR 1.604 (1.058 – 2.431) |  |  | All-cause mortality |  |  |
| (41) | 2017 | 10.1111/eci.12718 | 28036114 | Sweden | Complications | CACS | HR 1.52 (1.12-2.06) | v | CACS | Mortality | 5D-5T | 240 |
| (128) | 2015 | 10.3109/0886022X.2015.1077316 | 26336882 | Portugal? | complications | Simple  vascular calcification score (SVCS) | https://www.tandfonline.com/na101/home/literatum/publisher/tandf/journals/content/irnf20/2015/irnf20.v037.i09/0886022x.2015.1077316/20151009/images/medium/irnf_a_1077316_f0002_c.jpg | v | SVCS | Vascular access flow (DU-Qa) | 5D (HD) | 50 |
|  |  |  |  |  |  | Male gender | P = 0.575 |  |  |  |  |  |
| (129) | 2008 | 10.1111/j.1365-2362.2008.02032.x | 19021697 | Sweden | complications | Low fetuin-A | HR 2.2 (1.4–3.5) | x | Fetuin-A inhibits vascular calcification | Mortality | 5D (HD) | 222 |
|  |  |  |  |  |  |  | Patients with low fetuin-A levels (< median) had higher mortality (Hazard ratio ‘HR’ 2·2; CI 1·4–3·5, P< 0·001), but this association was lost after adjustment for age, gender, comorbidities score, dialysis vintage and inflammation (CRP > median). In inflamed patients with low fetuin a significantly independent association with mortality (HR 2·3; CI 1·2–4·5, P= 0·01) was observed compared to non-inflamed patients with high fetuin-A, after adjusting for the same variables. |  |  |  |  |  |
| (130) | 2016 | 10.15386/cjmed-515 | 27004031 | Romania | complications | male gender | HR 14.96 (2.09-106.98) | v | vascular or  other soft tissue calcifications (VC) by plain film | all-cause mortality | 5D (HD) | 92 |
|  |  |  |  |  |  | VC score | HR 1.30 (1.05-1.59) |  |  |  |  |  |
|  |  |  |  |  |  |  | HR 1.387 (1.095-1.757) |  | Cardiovascular mortality |  |  |  |
|  |  |  |  |  |  |  | Multivariable Cox analysis of CdV mortality used  as covariates age, gender, HD vintage, presence of DM,  VC score, presence of ROD, Ca in dialysis solution, oral  Ca salts, vitamin D treatment, serum Ca, P, iPTH, ALP,  creatinine, Hb, cholesterol, trygliceride, CRP, albumin,  ferritin levels, URR, spKt/V baseline renal disease, initial  CdV disease. The method was Forward LR stepwise.  VC score (HR=1.387; 95.0% CI 1.095-1.757; p=0.007)  and URR (HR=0.942; 95.0% CI 0.888-0.999; p=0.046)  remained in the ecuation. **Increased VC score and decreased**  **URR represent risk factors for CDV mortality.** |  |  |  |  |  |
| (131) | 2014 | 10.1007/s00223-013-9811-x | 24193439 | China | complications | Male gender | HR 0.225 (0.100-0.509) | ? |  | All-cause mortality | 5D | 120 |
|  |  |  |  |  |  |  | HR 0.043 (0.008-0.241) |  |  | cardiocerebrovascular  mortality |  |  |
| (132) | 2013 | 10.1186/1471-2369-14-263 | 24289833 | Canada | complications | Aortic arch calcification score (AoAC) | Score 1 1.52 [0.99, 2.34] 0.06 | x | AoAC | Mortality | 5D (HD) | 824 |
|  |  |  |  |  |  |  | Score 2 1.22 [0.72, 2.05] 0.47 |  |  |  |  |  |
|  |  |  |  |  |  |  | Score 3 2.49 [1.28, 4.82] 0.01 |  |  |  |  |  |
| (81) | 2014 | 10.1186/1471-2369-15-190 | 25465028 | Brazil | Complications? | Male sex (versus  female) | HR 0.82 (0.39-1.75), p = 0.620 | x |  | Mortality | 5D (HD) | 91 |
|  |  |  |  |  |  | Sclerostin | HR 2.18 (1.41-3.38) |  |  |  |  |  |
| (133) | 2018 | 10.1080/0886022X.2018.1455588 | 29619867 | Lithuania | Complications | Male gender | HR 2.89, p = 0.357 | x | aortic arch calcification | Cardiovascular event | 5T | 37 |
|  |  |  |  |  |  |  | Multivariate linear regression revealed that **donor age, donor gender, and recipient eGFRdischarge (R-squared 0.65, p = 0.002)** better predict eGFR1year than AoAC combined with recipient eGFRdischarge (R-squared 0.35, p = 0.006). During 1-year follow-up, four (10.81%) patients experienced **cardiovascular events**, which were predicted by **PWV ratio** (HR 7.549, p = 0.045), but **not related to AoAC score** (HR 1.044, p = 0.158). |  |  |  |  |  |
| (57) | 2014 | 10.1159/000368476 | 25571879 | Japan | Complications | Male gender | Univariate: HR 1.502 (0.624-4.163), p = 0.3772 |  |  | Cardiovascular mortality | 5D (HD) | 301 |
|  |  |  |  |  |  |  | Univariate: HR 1.485 (0.746-3.215), p = 0.2690 |  |  | All-cause mortality |  |  |
|  |  |  |  |  |  | AoAC Grade 1 | Univariate: HR 2.838 (1.053-8.920), p = 0.0390 |  |  | Cardiovascular mortality |  |  |
|  |  |  |  |  |  |  | Multivariate: HR 1.731 (0.616-5.623), p = 0.3065 |  |  |  |  |  |
|  |  |  |  |  |  | AoAC Grade 2+3 | Univariate: HR 4.636 (2.794-9.149), p = 0.0011 |  |  |  |  |  |
|  |  |  |  |  |  |  | Multivariate: HR 2.629 (1.455-5.124), p = 0.016 |  |  |  |  |  |
|  |  |  |  |  |  | AoAC Grade 2+3 | Univariate: HR 3.409 (2.015-5.781), p = 0.0261 |  |  | All-cause mortality |  |  |
|  |  |  |  |  |  |  | Multivariate: HR 1.699 (1.052-2.680), p = 0.0222 |  |  |  |  |  |
| (134) | 2011 | 10.1093/ndt/gfr089 | 21414968 | The Netherlands | Complications | Female gender | B = 3.14, β = 0.23, 95% CI -0.05–6.32, p = 0.05 | v |  | Capillary recruitment | 5D | 35 |
|  |  |  |  |  |  |  | Male -> rarefaction |  |  |  |  |  |
| (61) | 2013 | 10.1159/000334597 | 22143191 | Belgium | complications | Gender | Parameter estimate = 1.07001, p = 0.0182, HR 2.915 (1.2–7.08) |  |  | Cardiovascular events | 5T | 115 |
|  |  |  |  |  |  | AC present | Parameter estimate = 3.07957, p = 0.0024, HR 21.749 (2.97–159.4) |  | Aortic calcification |  |  |  |
|  |  |  |  |  |  | AC score | Parameter estimate = 0.16250, p <0.0001, HR 1.176 (1.11–1.244) |  |  |  |  |  |
| (135) | 2012 | 10.1159/000334597 | 22143191 | Belgium | complications | Female gender | Univariate: Parameter estimate = –7.9, p = 0.05, R2 = 0.014 | v |  | Prolonged corrected QT interval | 5T | 193 |
|  |  |  |  |  |  | Aortic calcification score | Univariate: Parameter estimate = 1.12, p= 0.0017, R2 = 0.045 |  | Aortic calcification score |  |  |  |
|  |  |  |  |  |  |  | In multivariate linear regression analysis, female gender, a higher aortic calcification score, hematocrit and PTH levels and lower calcium and potassium levels were found to be independently  associated with QTc. These variables explain 21% of the variability of QTc. Similar associations were found for JTc. |  |  |  |  |  |
| **(6)** | 2018 | 10.1007/s11255-017-1758-9 | 29236239 | Thailand | Complications | Male gender | CKD 2-5: HR 2.35 (0.93–5.91) |  |  | Mortality | 2-5T | 419 |
|  |  |  |  |  |  |  | CKD 5D: 1.14 (0.49–2.65) |  |  |  |  |  |
|  |  |  |  |  |  |  | KT: 1.36 (0.41–4.52) |  |  |  |  |  |
|  |  |  |  |  |  | AAC > 6 | CKD 2-5: HR 2.35 (1.05–5.25)\* |  | AAC |  |  |  |
|  |  |  |  |  |  |  | CKD 5D: HR 1.84 (0.77–4.39) |  |  |  |  |  |
|  |  |  |  |  |  |  | KT: HR 2.93 (0.9–9.22) |  |  |  |  |  |
|  |  |  |  |  |  | pelvic arterial calcification (PAC) > 1 | CKD 2-5: HR 3.04 (1.33–6.96)\*\* |  | PAC |  |  |  |
|  |  |  |  |  |  |  | CKD 5D: HR 2.64 (1.14–6.08)\* |  |  |  |  |  |
|  |  |  |  |  |  |  | KT: HR 13.9 (3.74–51.3)\*\* |  |  |  |  |  |
| (136) | 2006 | 10.1159/000095362 | 16940716 | Italy | Complications | Male gender | RR 0.85 (0.81–0.76), coefficient = –2.01, p = 0.001 | v |  | QT dispersion (QTd) | 4-5D (HD) | 46 |
|  |  |  |  |  |  | TC score ??? | RR 11.2 (8.22–16.7), coefficient = 1.571, p = 0.0001 |  |  |  |  |  |
|  |  |  |  |  |  |  | TC score到底是甚麼? |  |  |  |  |  |
| (137) | 2014 | 10.1007/s11255-013-0620-y | 24318369 | Japan | Complications | CS | OR 9.9759x1030 (12.528–7.9429x1060) |  | Calcification score |  | 5D (HD) | 49 |
|  |  |  |  |  |  | Male gender | OR 23.194 (1.452–370.372) |  |  |  |  |  |
| (138) | 2013 | 10.1093/ndt/gft039 | 23605174 | Belgium | complications | Male gender | HR 0.55 (0.25–1.19), p = 0.13 |  |  | All-cause mortality | 5D (HD) | 100 |
|  |  |  |  |  |  | Sclerostin | HR 0.33 (0.15–0.73) |  |  |  |  |  |
| (139) | 2016 | 10.1016/j.bone.2016.08.007 | 27519971 | Sweden | complications | CAC (>100 vs. ≤100 AUs) | RR 2.86 (1.26–6.45) 0.01 |  |  | Low Vertebral bone density (VBD) | 5 | 231 |
|  |  |  |  |  |  | Male gender | RR 1.22 (0.62–2.39), p = 0.57 |  |  |  |  |  |
| (140) | 2009 | 10.1093/ndt/gfp253 | 19491380 | UK | complications | Male gender | OR 8.06 (1.34–48.450) |  |  | All-cause mortality | 4-5D | 134 |
|  |  |  |  |  |  | OPG >25 pmol/L | OR 5.31(1.35–20.88) |  |  |  |  |  |
| (141) | 2005 | 10.1111/j.1523-1755.2005.00345.x | 15882283 | Sweden | Complications | Male gender | RR 1.30 (0.83-2.02), NS |  |  | All-cause mortality | 5 | 258 |
|  |  |  |  |  |  |  | RR 1.32 (0.77–2.25), NS |  |  | Cardiovascular mortality |  |  |
|  |  |  |  |  |  | Low Fetuin-A | 2.58 (1.64–4.07) |  |  | All-cause mortality |  |  |
|  |  |  |  |  |  |  | 2.63 (1.51–4.59) |  |  | Cardiovascular mortality |  |  |
| (142) | 2005 | 10.1111/j.1523-1755.2005.00233.x | 15780108 | France | Complications | Male = 1, female = -1 | β = −0.48, HR 0.62, p = 0.0043 |  |  | First fatal or nonfatal cardiovascular event | 5D (HD) | 179 |
|  |  |  |  |  |  | Log (calciﬁcation score) | β = 0.90, HR 2.46, p <0.0001 |  |  |  |  |  |
|  |  |  |  |  |  |  | 18% of variance explained. |  |  |  |  |  |
| (143) | 2016 | 10.5301/jva.5000591 | 27516144 | Singapore | Complications | Male gender | OR 1.99, SD = 0.22 |  |  | Arteriovenous fistula secondary patency | 5D | 436 |
|  |  |  |  |  |  | Calcified radial artery | Secondary patency vs. primary failure: 12% vs. 25%, p = 0.002 |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |

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