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**DIAGNOSTIC AND PROGNOSTIC VALUE OF CORONARY COMPUTED TOMOGRAPHY ANGIOGRAPHY IN PATIENTS WITH SEVERE CALCIFICATION**


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**ABSTRACT**

Our aim was to analyze its diagnostic and prognostic value in patients with high coronary calcium score (CCS).

**Methods:** A total of 113 patients with CCS>400 were included. Significant coronary artery disease (CAD) was defined as stenosis ≥50%. Invasive coronary angiography and major cardiovascular events were recorded.

**Results:** The CCS and heart rate during the acquisition were significantly lower in the diagnostic coronary computed tomography angiography (CCTA) group. The cut-off value of CCS to establish the diagnostic utility of CCTA was 878. The rate of cardiovascular events was 9.3%. The positive predictive value of CCTA to detect significant CAD was 73.5% and the negative predictive value for predicting cardiovascular events was 96%.

**Conclusions:** In patients with high CCS, CCTA is useful to evaluate CAD, especially when the CCS is lower or equal to 878; moreover, the prognostic value of CCTA is better in patients where significant CAD has been ruled out.

**Keywords:**

Coronary calcium score; non-invasive coronary angiography; multidetector computed tomography

## INTRODUCTION

Coronary computed tomography angiography (CCTA) has been established in clinical practice as a non-invasive technique capable of accurately estimating coronary calcification and the presence of coronary stenosis [1]. However, although coronary calcification is a marker of atherosclerosis [2] and a good predictor of cardiovascular events [3], it hinders analysis of CCTA images, because the vascular lumens cannot be clearly visualized, making it difficult to evaluate the severity of the coronary lesions. In fact, extensive coronary calcification has classically been considered as a relative contraindication to performing CCTA [4]. Hence, several works have described a specific calcium threshold above which angiography is not recommended, owing to limited diagnostic cost-effectiveness [5]. In recent years, with the emergence of the newest CCTA technology, the diagnostic correlation between invasive and non-invasive angiography has improved, even for the evaluation of severely calcified segments [6,7]. These advances have resulted in a greater number of CCTA being performed in cases of severe calcification in clinical practice. However, the diagnostic and prognostic value of this technique in this patient group is still uncertain and evidence is contradictory about its benefits in individuals with a high coronary calcium score (CCS) calculated by the Agatston method [8,9].

The aim of our work was to assess the diagnostic and medium term prognostic value of CCTA in patients with severe coronary calcification detected in non-contrast CCTA images.

## METHODS

CCTA referred to our center from a two years period, from January 2014 to December 2015 (n= 1858), were retrospectively and consecutively assessed, and cases presenting a CCS ≥400 were selected. Patients with a history of established coronary artery disease (CAD) were excluded from the study. Informed consent was obtained from each patient and the study was approved by the hospital ethics committee . "Código CEIm HM Hospitales:17.12.1145-GHM"

The studies were acquired using a Toshiba® Aquilion Prime (Toshiba Medical Systems, Otawara, Japan) system equipped with 64 detectors. Before each examination, patients were medicated with endovenous Metoprolol (at a dose of 5 to 20 mg) to achieve a heart rate below 65 bpm and sublingual nitroglycerine (0.6 mg) was used as a coronary vasodilator. The examination protocol included CCTA images without contrast to calculate the CCS, followed by a CCTA with contrast medium to study the coronary tree. The acquisition volume extended from the tracheal carina to the inferior border of the heart. Images without contrast were obtained prospectively in the 75% cardiac cycle phase, using 100 KV, 250 mA and a section thickness of 3 mm. Then, arterial angiography was performed with contrast using either retrospective acquisition or retrospective dose modulation protocol. The parameters of current intensity and radiation energy were adjusted in relation to body surface area. The volume of contrast medium injected (Ultravist® 370 mg/ml) was calculated in relation to scanning time and patient weight with an infusion rate of 4.5-5 ml/s. The bolus tracking technique was used (ROI in ascending aorta) and all the cardiac phases were reconstructed.

The images were assessed by a cardiologist from the Imaging Unit with broad experience in CCTA (more than 3,000 studies in 5 years), using a Vitrea work station (Vitrea®, vital images, Plymouth, MN, US). For coronary calcium quantification, the CCS was calculated with the Agatston method and three groups of varying degrees of severity were defined according to established cut-offs [9]: Group I: CCS= 400-1000; Group II: CCS=1001-2000 and Group III: CCS >2000, to explore the CCTA diagnostic accuracy and the CAD distribution across different calcium score categories.

CCTA images were analyzed using maximum intensity projection and volumetric multiplanar reconstructions. The coronary arteries were divided into 17 segments according to the American Heart Association classification [10]. Lesion severity was graded visually. CAD was considered as non-significant when narrowing of the vascular lumen was <50%, and significant (CADs) when stenosis was ≥50% (moderate stenosis from 50-70% and severe stenosis >70%). The study quality was considered diagnostic or non-diagnostic depending on the interpretability of the CCTA images. The study was considered non-diagnostic when at least two of the main coronary segments, in particular the proximal and mid segments, could not be assessed, unless a significant stenosis was observed in any segment, which changed the study into a diagnostic one. This definition is supported by the expert consensus document of the Society of Cardiovascular Computed Tomography (CAD-RADS$^{TM}$: reporting and data system) [11]. They recommend that if a study is not fully diagnostic (i.e. not all segments could be interpreted with confidence), but a significant stenosis is present in a diagnostic segment, the highest stenosis is graded and the study is considered as diagnostic, since CCTA can guide patient management.

The following clinical variables were obtained using questionnaires before study acquisition: sex, age, cardiovascular risk factors (CVRF) including arterial hypertension, dyslipidemia, diabetes mellitus and active smoking, ischemia detection tests and reason for requesting the test. Data recorded related to CCTA acquisition included the medication taken and the heart rate. In patients with chest pain, we calculated the pretest probability of having CAD, as recommended by the ESC guidelines on the management of stable CAD [12]. This probability includes age, gender and the nature of symptoms (typical angina, atypical angina, non-anginal chest pain). Accordingly, our population study was classified into those with a low (<15%), intermediate (15-65%), high (66-85%) and very high pretest probability (>85%) of having CAD.

Follow up data were obtained by studying the clinical records and by telephone questionnaires with patients. We recorded the initial attitude of the physician ordering the study to the CCTA result, the performance of invasive coronariography and the need for revascularization, the presence of major cardiac adverse events (MACE) in the medium term, including myocardial infarction, the need for late revascularization (>90 days) and cardiovascular mortality, and also, global mortality [13]. Figure 1 shows the distribution of the study population related to the CCTA results and their clinical follow-up, including the physician's initial attitude after CCTA to indicate invasive coronariography and/or revascularization and the MACEs detected.

For the descriptive analysis, the categorical variables were represented by showing the number of cases and their percentages and were compared by the Chi-squared or Fisher's test. Continuous variables were represented as means and their standard deviations and were compared by the Student's t-test for independent samples. For non-normal distributions, non parametric tests were applied. Statistical analyses were carried out using the SPSS program version 21. The ROC curve was obtained using the Python statistic library, namely the scipy.stats library to define the diagnostic accuracy of CCTA in patients with severe calcification and the Youden index was calculated. For this calcium value, the sensitivity, specificity and positive and negative predictive values were determined.

**RESULTS**

A total of 135 CCTA studies of CCS≥400 were identified. Of these, 22 cases were excluded for established CAD, so the final study population corresponded to 113 patients. Most of the patients (81%) were male and the mean age was 68 years, SD 9.7 years. The most common CVRF was arterial hypertension (62.8%), followed by dyslipidemia (52.2%), smoking (23%) and diabetes mellitus (22.1%). It is noteworthy that 54% of patients presented a high CVRF burden (≥2 FRCVs). The most common reasons for ordering the CCTA corresponded to chest pain (33.6%), inconclusive or pathological stress test findings and segment alterations in the ECG of asymptomatic patients (25.6%), patients in cardiology checkups or with a high CVRF burden (20.4%), and patients requiring presurgical assessment (11.5%). It is important to highlight that 78% (n = 41) of ischemia detection tests in patients referred for CCTA were positive. In the subgroup of patients with chest pain (n=39), the pretest probability of CAD was intermediate, high and very high in 71%, 14% and 15% of cases, respectively, with no patient presenting a low probability.

The distribution of CCS in our study population had a mean value of 1129, SD 921, median of 798 and a range of 400-5924. Most cases were included in the CCS category from 400-1000. Clinical differences were not found in patients in relation to their CCS (Table 1).

Table 2 shows the clinical characteristics and parameters of CCTA in relation to the quality of the studies and the severity of the coronary lesions. Out of all the CCTA performed, 88% (99/113) were classified as diagnostic CCTA and 12% (14/113) as non-diagnostic CCTA. In the diagnostic CCTA group, both heart rate during acquisition and CCS were significantly lower than in the non-diagnostic CCTA group. There were no differences in CVRF in relation to CAD severity (p>0.05 for all comparisons), whereas chest pain and positive ischemia tests were significantly more prevalent in the group of patients with significant CAD.

Figure 2.A. shows the relationship between the quality of CCTA and the severity of coronary calcification, in relation to patients classification into Groups I (CCS=400-1000), II (CCS=1001-2000) and III (CCS>2000). A greater prevalence of diagnostic studies was observed in Groups I and II compared with Group III (94.3% and 86.7% vs 53.8%, p<0.05), although there were no differences between Groups I and II. Figure 3 shows the ROC curve obtained for the calcium value as a function of whether the CCTA were diagnostic. The area under the curve for the CCS in relation to whether CCTA were diagnostic or not was 0.77 and the sensitivity and specificity of the CCTA were determined for different values of calcium. For every CCS value in the ROC curve, we have evaluated the Youden index. CCTA was considered as non diagnostic above a CCS of 878, which it is the point with the highest index, and had a sensitivity of 0.63 (CI 95% 0.53-0.72), specificity of 0.85 (CI 95% 0.56-0.97), positive predictive value of 0.97 (CI 95% 0.88-0.99) and a negative predictive value of 0.25 (CI 95% 0.14-0.39). In the diagnostic CCTA, the prevalence of CAD was 66.7%, of which 56% of cases corresponded to moderate CAD and 44% to severe CAD. Figure 2.B shows the relationship between the presence of non significant CAD in the CCTA and the severity of coronary calcification according to Groups I, II or III. A greater prevalence of non significant CAD was observed in Group I compared with Group III (35.7% versus 7.7%, p<0.05), with no differences between either of these groups and Group II. Figure 4 shows examples of patients with severe coronary calcification and different results in the CCTA.

Clinical follow up was obtained in 97 patients (85.8%), with a mean follow up of 25 months (interquartile range [19-31]). With regards to the initial attitude, invasive coronariography was indicated in 41 patients (42%), 35 (41.7%) from the diagnostic CCTA cases and 6 (46.2%) from the non-diagnostic CCTA cases (p=0.8). Invasive coronariography was more often requested in patients in whom the CCTA had detected CADs compared to patients without CADs (60.7% versus 3.6%, p<0.05). Of the 34 patients with CADs in the CCTA who received a coronariography, 25 (73.5%) presented severe stenosis (>70%) in this study whereas in the patients without CADs detected in the CCTA (n=28) only one (3.6%) received a coronariography, which revealed no significant lesions. The positive predictive value of the CCTA to detect CADs was 73.5% (CI 95%: 55-86). In the non diagnostic CCTA group all the patients with invasive coronariography showed severe lesions.

A total of 9 cardiovascular events (6 late revascularizations, 1 myocardial infarction, 2 cardiovascular deaths) were recorded in the medium term follow up, implying a MACE rate of 9.3% (4.6% per year). Five deaths were registered during follow-up**,** 2 patients died from cardiovascular causes (as mentioned above) and 3 patients died from non-cardiac causes due to oncologic processes, leading to an overall mortality rate of 5%. Cardiac causes of death included one case from coronary dissection after percutaneous revascularization and one case from postoperative complications after ascending aorta aneurysm surgery and bypass-grafting. In patients with diagnostic CCTA, the rate of MACEs was 7.1% compared with 23.1% in patients with non diagnostic CCTA (p=0.06). In patients without CADs, the rate of MACEs was 3.6% (1 event) compared with 8.9% (5 events) in patients with CADs (p=0.36). With regards to the CCS, the rate of MACEs was 5.2%, 11.1% and 25% in Groups I, II and III, respectively (p<0.05 between Group I and III). The negative predictive value of the CCTA to predict MACEs in the absence of CADs during follow up was 96% (CI 95% 80-99).

**DISCUSSION**

In spite of the proven diagnostic cost-effectiveness of CCTA to evaluate CAD [1], its value in patients with severe coronary calcification is still unknown. In our study, we have shown that CCTA is useful to assess almost 90% of patients with extensive coronary calcification, especially when the CCS is lower or equal to 878 and the heart rate during the study is optimized. Despite a high amount of calcium, we could conclude from CCTA images that two-thirds of our study population had CADs, of which half had severe CAD, and CADs were ruled out in a third of the patients. We also observed that when CCS severity was lower, the prevalence of non significant CAD was higher, as well as the probability of being a diagnostic study. Although it is well known that CCTA is inaccurate to assess the vascular lumen in the presence of high calcification, our study has shown a good correlation between CADs assessed by CCTA and by coronariography, with almost 75% of the cases with CADs detected by CCTA being subsequently revascularized. Another relevant finding is that the rate of cardiovascular events was lower in patients in whom CCTA had ruled out CADs. It would, therefore, be justified to perform CCTA in this setting as it can accurately identify or rule out the presence of CADs, and would improve the medium term prognosis in these patients.

The problem from the calcium deposition in the coronary arteries wall is that produces blooming and beam-hardening artifacts that make difficult the visualization of the vessel lumen [4]. Several publications have reported reduced diagnostic accuracy with CCTA in the presence of extensive coronary calcification [14-16]. Our study, along with more recent publications [6,7], presents better results in this setting, owing to a greater number of diagnostic studies, technological improvements (more detectors, iterative reconstruction algorithms etc.) and the extensive experience of the medical team. As expected and according to previous publications [17] we have observed an association between diabetes mellitus and extensive coronary calcification.

Previous CCTA studies have revealed that correct visualization of the vessel is largely dependent on the heart rate during acquisition [18]. In fact, they strongly emphasize the importance of reducing heart rate to <65 bpm to limit movement artifacts and improve image quality. In studies of extensive coronary calcification, it is even more important to obtain an optimum heart rate, as shown here, so the use of beta-blockers is highly recommended. The aim is to prevent movement artifacts caused by high heart rates from adding to the calcium artifacts, which would make visual interpretation of the lumen even more difficult. To date, a high CCS is defined as >400, and thus, many centers will not perform CCTA above this value [5]. The results obtained here support the diagnostic value of CCTA in the presence of severe calcification, with added value if the CCS is below or equal to 878. However, at CCS values >2000, the number of non-diagnostic CCTAs is significantly higher and its diagnostic worth is questionable. The range of CCS values between 879 and 2000 is a grey area. Here, the decision to perform angiography must be individualized, taking into account the symptomatology and the pretest probability of CAD, the CVRF, the heart rate and other factors involved in poor image quality, and calcium distribution. Very extensive calcified plaques that affect proximal coronary segments tend to make interpretation more complex compared to focal calcified plaques distributed in a more disperse and diffuse manner throughout the coronary tree [7].

The presence of CAD in asymptomatic individuals with multiple CVRF or in symptomatic patients with inconclusive ischemia tests is a matter of concern for both cardiologists and patients alike. Since CCTA is a well-tolerated, non-invasive technique with a high negative predictive value this test is frequently requested in standard clinical practise. Our series mainly represents an intermediate risk of CAD, in which CCTA was performed in accordance with clinical guidelines [12], and in most cases could establish the severity of the CAD despite a high CCS, without the need for invasive tests. Moreover, CCTA has detected a high prevalence of CADs in our population, of almost 70%, and severe CAD of 30%, in line with previous studies. However, the prevalence of CAD assessed with CCTA in patients with severe calcification differs greatly in different publications. Ho et al. [19] found a prevalence of CADs of 20-27%, defined as obstructive lesions >60% in a group of patients with CCS >400, in whom CVRF was the main indication for the test. By contrast, De Agustin et al. [5] reported a prevalence of severe CAD in over 85% of symptomatic patients with CCS>400. Another advantage of the CCTA is the possibility to provide information about coronary anatomy and the extension of the atherosclerosis, which may enable physicians to optimize the therapeutic management of patients.

Our study results are timely and aligned to those recently presented in the ISCHEMIA Trial. This is a breakthrough research study that supports the use of CCTA in clinical practice. Briefly, this trial did not show any differences in the primary endpoint (cardiovascular death, myocardial infarction, resuscitated cardiac arrest, unstable angina, or heart failure) between initial invasive or conservative treatment strategies for managing stable ischemic heart disease in patients with moderate or severe ischemia on stress testing. Interestingly, CCTA was the imaging modality of choice in the ISQUEMIA trial to exclude participants with either left main coronary stenosis or those without obstructive CAD, supporting the diagnostic value for CAD [20,21]. Emerging technologies such as fractional flow reserve derived from CCTA and myocardial CT perfusion could provide additional functional evaluation of CAD in one single technique. This information could be especially interesting in severely calcified or intermediate lesions and could help the physician to better identify those patients who may benefit from coronary revascularization. However, these technologies are not widely available yet and would imply using the last generation CT scanners [22,23].

On the other hand, the presence of CAD assessed by non-invasive angiography has been shown to be a good predictor of cardiovascular events and mortality in the medium and long-term in symptomatic individuals without a high degree of coronary calcification [24]. In this line, a subanalysis of the CONFIRM register has been published recently showing the prognostic value at 29 months of non-invasive angiography in asymptomatic individuals stratified by CSS severity. They concluded that non-invasive angiography improves the prediction of future fatal and non-fatal cardiovascular events in patients with moderate CCS (100-400UA) but does not improve the prediction in individuals with lower (<100 UA) or higher (>400 UA) scores [8]. In our population with CCS>400, the number of MACEs was low in the medium term, especially in patients without CADs (1 event). Our 25 months mean follow up is similar to the follow up reported in previous publications evaluating the prognostic value of CCTA. For example, Cho et al evaluated the prognostic utility of CCTA for asymptomatic patients based on CCS severity during a median follow up of 24 months [8] and Dedic et al compared the prognostic value of CCTA, CCS and exercise electrocardiography in symptomatic patients during a median follow up of 30 months [25].

The negative predictive value of CCTA for the prediction of MACEs was high during the first year of follow up, reaching 96%, although this data must be interpreted with caution owing to the low number of events recorded.

Limitations.

This is a retrospective study carried out in a single centre with a limited number of patients. In spite of this, we consider that our work reflects the real practical situation faced today, in which there is an increasing number of CCTAs carried out in the presence of severe coronary calcification and could help to decide whether to perform CCTA or not in a given case. On the other hand, the absence of follow-up in some patients precluded evaluation of the prognostic value of CCTA (n=16); however, similar losses of patients during follow-up have been reported [26] and the diagnostic value of CCTA could be assessed in all patients. Invasive coronariography was performed in a limited number of patients (42%) following the clinical cardiologist's criterion, which could limit the reliability of CCTA findings in those without angiography. Nevertheless, this strategy reflects the current patient´s management according to clinical guidelines because the high negative predictive value of CCTA precludes the need for further studies and revascularization only improves prognosis in high-risk CAD patients [1,12,27]. Furthermore, there is evidence for a high concordance between CCTA and coronary angiography. To calculate the negative predictive value, the presence or absence of cardiovascular events during follow up was used. However, large multicentric studies with long follow up periods are required to accurately determine the prognostic value of CCTA in patients with extensive coronary calcification.

## CONCLUSIONS

In patients with severe calcification, CCTA was diagnostic for CAD in near 90% of the studies with the capability to detect CADs in two-thirds of patients. CCS values lower or equal to 878 and optimization of the heart rate during study acquisition are key to improving the diagnostic value of CCTA. The rate of MACEs in the medium term detected in our population was lower in the studies in which CCTA ruled out CADs. A high CCS should, therefore, not be considered as a contraindication for CCTA.

**Clinical relevance of the manuscript**: We have shown that CCTA is useful for evaluating CAD in almost 90% of patients with extensive coronary calcification, especially if the CCS is lower or equal to 878 and the heart rate is optimized. Cardiovascular events are lower when CCTA excluded CADs, which provides prognostic value in the medium term. Thus, a high CCS should, therefore, not be considered as a contraindication for CCTA."

**NOTES**

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**Compliance with Ethical Standards:**

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- **Conflict of Interest**: All authors declare that they have no conflict of interest

- **Ethical approval**: all procedures performed were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants includes in the study.

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## FIGURE LEGENDS

**Figure 1.** Distribution of the population relative to coronary computed tomography angiography and follow up. CAD: coronary artery disease; CCS: coronary calcium score; CCTA: coronary computed tomography angiography.

**Figure 2**. **A.** Prevalence of diagnostic coronary computed tomography angiography studies in relation to coronary calcium score. **B:** Prevalence of non-significant coronary artery disease in relation to coronary calcium score.

**Figure 3** shows the ROC curve that was obtained for the calcium value as a function of whether the CCTA were diagnostic.

**Figure 4.** Association between the presence of high coronary calcium score (superior) and coronary computed tomography angiography (inferior). Case 1 presents non-significant lesions (arrow,1b), case 2 presents severe lesions (arrow, 2b) and in case 3 the vessel cannot be visualized (arrow, 3b). CCS: coronary calcium score

**Table 1.** Clinical characteristics relative to coronary calcium score

| | **Group I (CCS 400-1000) (n= 70)** | **Group II (CCS 1001-2000) (n=30)** | **Group III (CCS>2000) (n=13)** | **P** |
|---|---|---|---|---|
| Age (years) | 67.56 ± 10.21 | 69.97 ± 8.5 | 73.23 ± 8.5 | 0.11 |
| Male | 54 (77.1) | 24 (80) | 13 (100) | 0.16 |
| Arterial hypertension | 41 (58.6) | 22 (73.3) | 8 (61.5) | 0.06 |
| Dyslipidemia | 37 (52.9) | 17 (56.7) | 5 (38.5) | 0.18 |
| Diabetes mellitus | 15 (21.4) | 5(16.7) | 5 (38.5) | 0.02 |
| Active smoking | 16 (22.9) | 7 (23.3) | 3 (23.1) | 0.16 |
| ≥ 2 CVRF | 35 (50) | 19 (63.3) | 7 (53.8) | 0.08 |

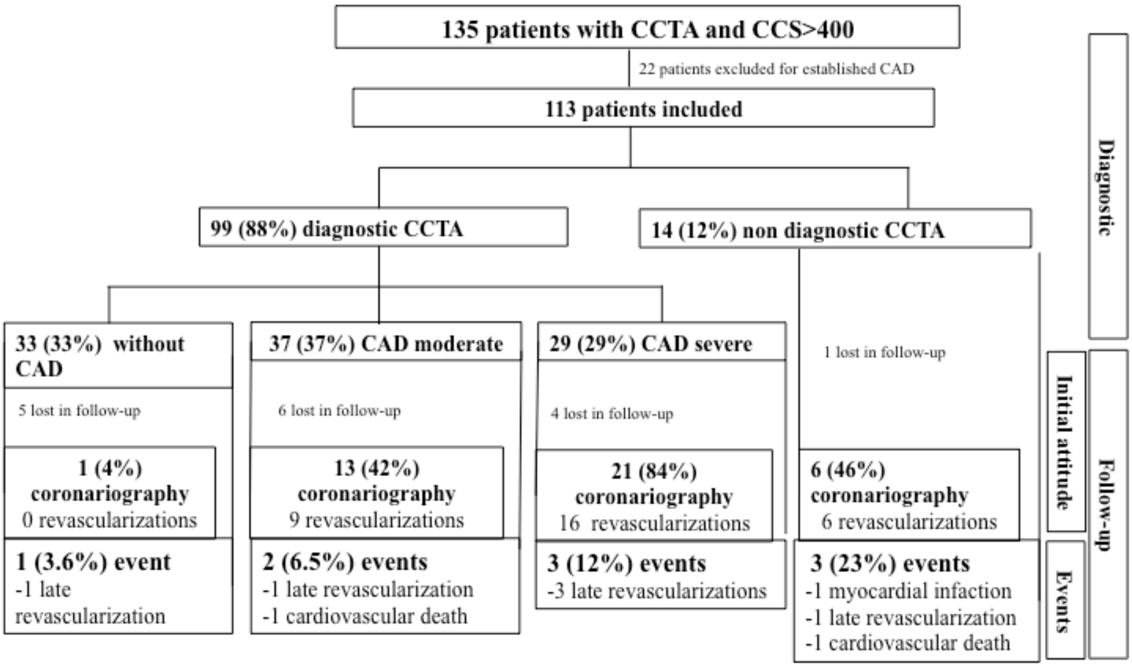
Data are number (%) or mean ± SD. CCS=coronary calcium score. CRVF=cardiovascular risk factors.

**Table 2.** Clinical characteristics of the study population and parameters related to the quality of the coronary computed tomography angiography.

| | **Diagnostic CCTA (n=99)** | | | **Non diagnostic CCTA (n=14)** | **P** |
|---|---|---|---|---|---|
| | **All** | **CAD<50% (n=33)** | **CAD ≥50% (n=66)** | | |
| **Clinical characteristics** | | | | | |
| Age (years) | 68.64 ± 9.7 | 68.15 ±10.22 | 68.88 ± 9.66 | 70.36 ± 9.4 | 0.53 |
| Male | 79(79.8) | 25 (75.7) | 54 (81.8) | 12 (85.7) | 1 |
| Arterial hypertension | 63 (63.6) | 24 (72.7) | 39 (59) | 8 (57.1) | 0.71 |
| Dyslipidemia | 54 (54.5) | 18 (54.5) | 36 (54.5) | 5 (35.7) | 0.73 |
| Diabetes mellitus | 20 (20) | 10 (30.3) | 10 (15.1) | 4 (28.6) | 0.15 |
| Active smoking | 22 (22.2) | 8 (24.2) | 14 (21.2) | 5 (35.7) | 0.27 |
| ≥ 2 CVRF | 54 (54.5) | 18 (54.5) | 36 (54.5) | 7 (50) | 0.73 |
| Ischemia detection tests | 36 (36.3) | 8 (24.2) | 28 (42.4) | 5 (36) | 0.63 |
| *Positive results* | 30 (83.3) | 5 (62.5) | 25 (89.2)* | 2 (40) | 0.34 |
| Chest pain | 32 (33.3) | 5 (15.1) | 27 (40.9)* | 7 (50) | 0.24 |
| **Cardiac tomographic parameters** | | | | | |
| Heart rate | 62.75±9.08 | 63.55 ±12.27 | 62.34±6.96 | 68.14 ± 8.7 | 0.048 |
| CCS | 1020 ±790 | 872±538 | 1094±884 | 1898 ±1371 | 0.001 |

Data are number (%) or mean ± SD. CAD= coronary artery disease. CCS=coronary calcium score. CCTA=coronary computed tomographic angiography. CRVF=cardiovascular risk factors. *p<0.05 calculated for the CAD >50% compared to the CAD<50%.

Figure 1



135 patients with CCTA and CCS>400
22 patients excluded for established CAD
113 patients included
99 (88%) diagnostic CCTA
14 (12%) non diagnostic CCTA
33 (33%) without CAD
37 (37%) CAD moderate
29 (29%) CAD severe
1 lost in follow-up
5 lost in follow-up
6 lost in follow-up
4 lost in follow-up
1 (4%) coronariography
0 revascularizations
13 (42%) coronariography
9 revascularizations
21 (84%) coronariography
16 revascularizations
6 (46%) coronariography
6 revascularizations
1 (3.6%) event
-1 late revascularization
2 (6.5%) events
-1 late revascularization
-1 cardiovascular death
3 (12%) events
-3 late revascularizations
3 (23%) events
-1 myocardial infaction
-1 late revascularization
-1 cardiovascular death
Diagnostic
Initial attitude
Events
Follow-up

Figure 2

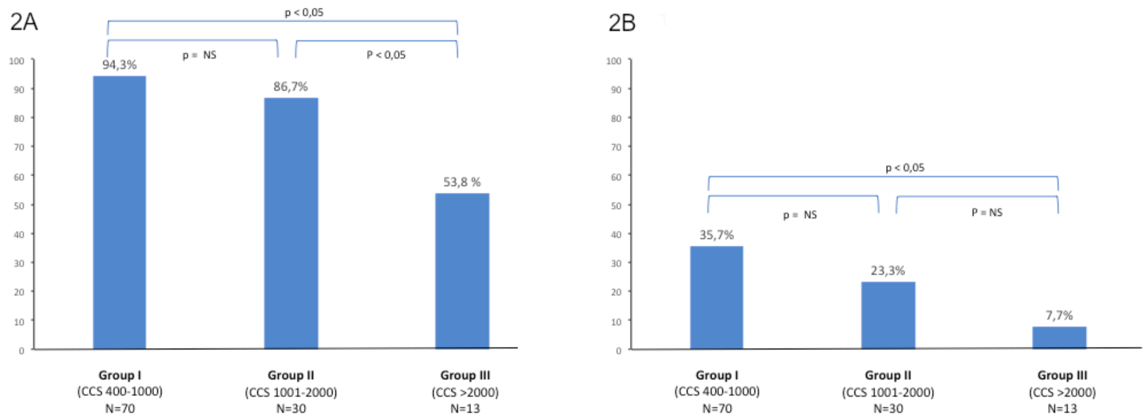

2A
p < 0,05
p = NS
P < 0,05
100
90
80
70
60
50
40
30
20
10
0
94,3%
86,7%
53,8 %
Group I
(CCS 400-1000)
N=70
Group II
(CCS 1001-2000)
N=30
Group III
(CCS >2000)
N=13
2B
p < 0,05
p = NS
P = NS
35,7%
23,3%
7,7%
Group I
(CCS 400-1000)
N=70
Group II
(CCS 1001-2000)
N=30
Group III
(CCS >2000)
N=13

Figure 3

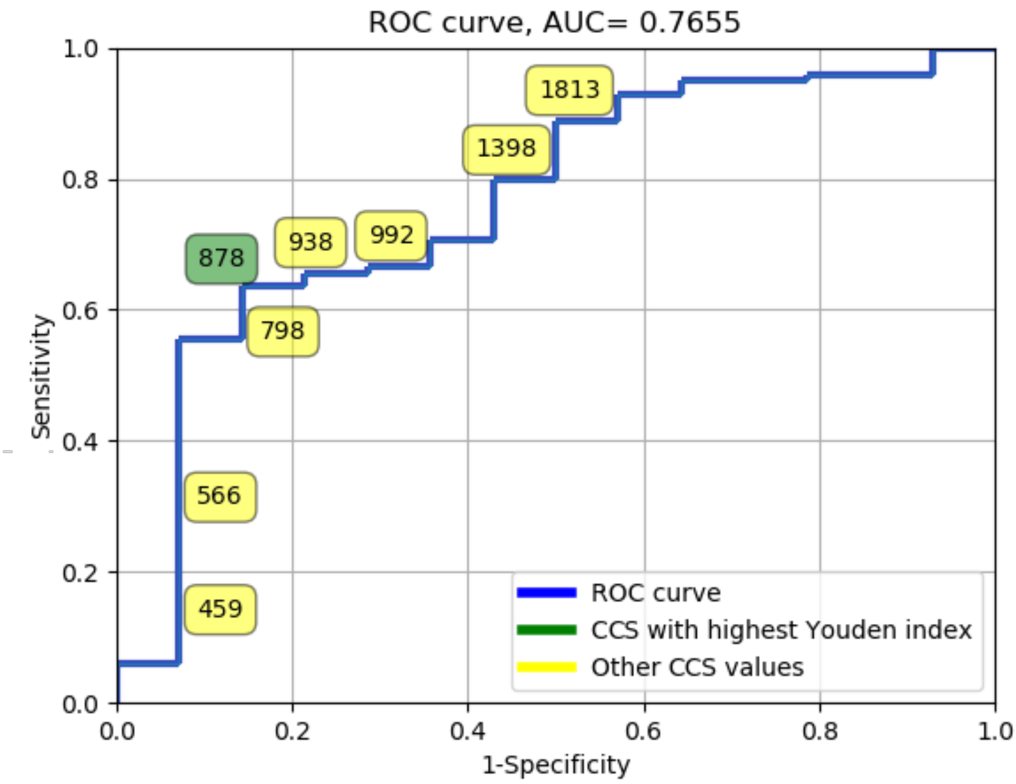
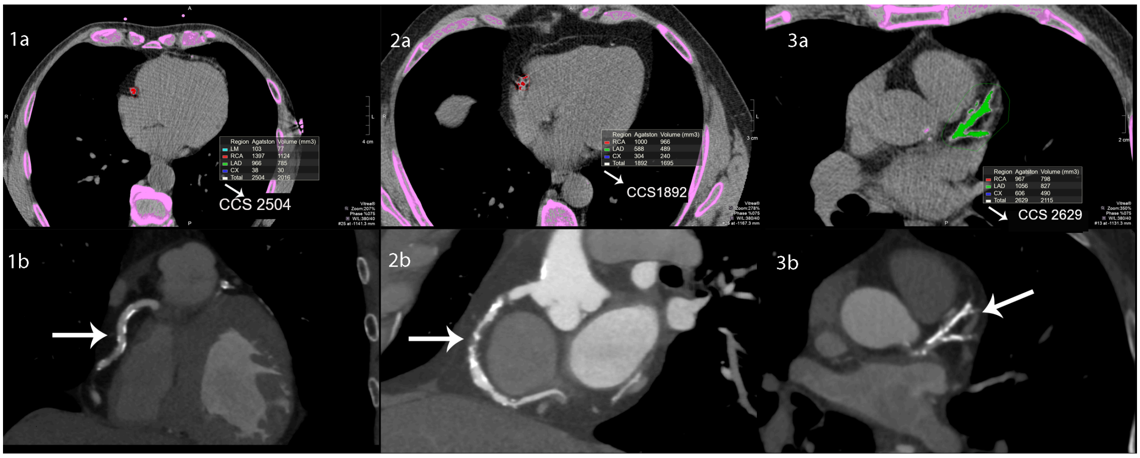

ROC curve, AUC= 0.7655
1.0
0.8
0.6
0.4
0.2
0.0
Sensitivity
0.0
0.2
0.4
0.6
0.8
1.0
1-Specificity
1813
1398
878
938
992
798
566
459
ROC curve
CCS with highest Youden index
Other CCS values

Figure 4


1a
Region Agatston Volume (mm3)
LM 103 77
RCA 1397 1124
LAD 966 785
CX 38 30
Total 2504 2016
CCS 2504
4 cm
Vitrea®
Zoom:207%
Phase %075
W/L:380/40
#25 at -1141.3 mm
2a
Region Agatston Volume (mm3)
RCA 1000 966
LAD 588 489
CX 304 240
Total 1892 1695
CCS1892
3 cm
Vitrea®
Zoom:278%
Phase %075
W/L:380/40
#25 at -1167.3 mm
3a
Region Agatston Volume (mm3)
RCA 967 798
LAD 1056 827
CX 606 490
Total 2629 2115
CCS 2629
2 cm
Vitrea®
Zoom:350%
Phase %075
W/L:380/40
#13 at -1131.3 mm
1b
2b
3b