Correlation of CT calcium scoring with the ACC/AHA ASCVD risk algorithm and Framingham score: a study at a mexican private preventive care centre

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Aims and objectives

Coronary Artery Disease is a main cause of mortality around the globe.

According to the World Health Organization (WHO), cardiovascular disease is a group of conditions that affect the heart and blood vessels.

Approximately 17.5 million people died because of cardiovascular disease in the year 2012, which represent 30% of the total. 7.4 million of them were caused by coronary disease and 6.7 million were caused by acute stroke, moreover, it affects predominantly medium income countries.

Regarding the risk factors, unhealthy diet habits and physical inactivity rise the risk for myocardial infarction and acute stroke.

It is predicted, that by 2020, more than 23 million people will die because of cardiovascular disease, moreover, it will remain as the major cause of death[1].

A study by Posadas-Romero C. et al [2] was published in the year 2017, which estimates that the prevalence of coronary artery disease in the mexican population is 40% in men and 14% in women, which is considerably different in comparison with the MESA study, which considers the prevalence for men as high as 57.9% and 25% for women in Hispanic population. It is important to notice that the term "hispanic" is not well stablished and it englobes a vast number of latin-american spanish-speaking population, while it ignores their ethnic background.

CT calcium scoring is an imaging tool to determine the burden of calcified plaques in coronary vessels, one of the most used methods is the Agatston score, which gives a weighting factor for each voxel depending on their Hounsfield unit and then multiplied by the area of calcification[3].

Based on the Agatston calcium score, patients are classified as zero,minimal, mild, moderate or severe risk for coronary artery disease[4, 5]. Nonetheless, one limitation of this method is to determine the clinical approach for patients in intermediate cathegories. Therefore, it is important to correlate the coronary plaque burden with other cardiovascular risk tools such as the ACC/ AHA ASCVD risk algorithm in order to give a more specific treatment for each patient.

The purpose of this work is to determine the correlation of CT calcium scoring and clinical cardiovascular risk tools in asymptomatic patients at our Institution in Mexico City.

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Methods and materials

Calcium Score studies are made at our Institution with a Philips Brilliance 64-slice CT Scanner. The images were obtained with ECG-gating. Each slice has a 3mm thickness, tube voltage of 120 kVs with a radiation dose less than 2 mSv. All studies were interpreted by radiologists and cardiologists with speciality in Cardiovascular imaging.

Clinical and laboratory data necessary for the Framingham risk score calculator and the AHA/ACC ASCVD risk algorithm were obtained from the personal file of each patients with their previous consent. This data included: age, gender, LDL, HDL and total cholesterol levels, systolic and dyastolic blood pressure values, smoking habit, previous diagnose of systemic arterial hypertension and previous diagnose of diabetes mellitus.

Each one of the already mentioned variables were obtained on the same day that the calcium scoring scans were performed.

The data was stored in an Excel spreadsheet and processed by the SPSS Statistics 25 by IBM® programme for the statistical analysis.

The correlation between Agatston calcium score, Framingham score and the ACC/AHA ASCVD risk algorithm was performed with the Spearman method.

Images for this section:

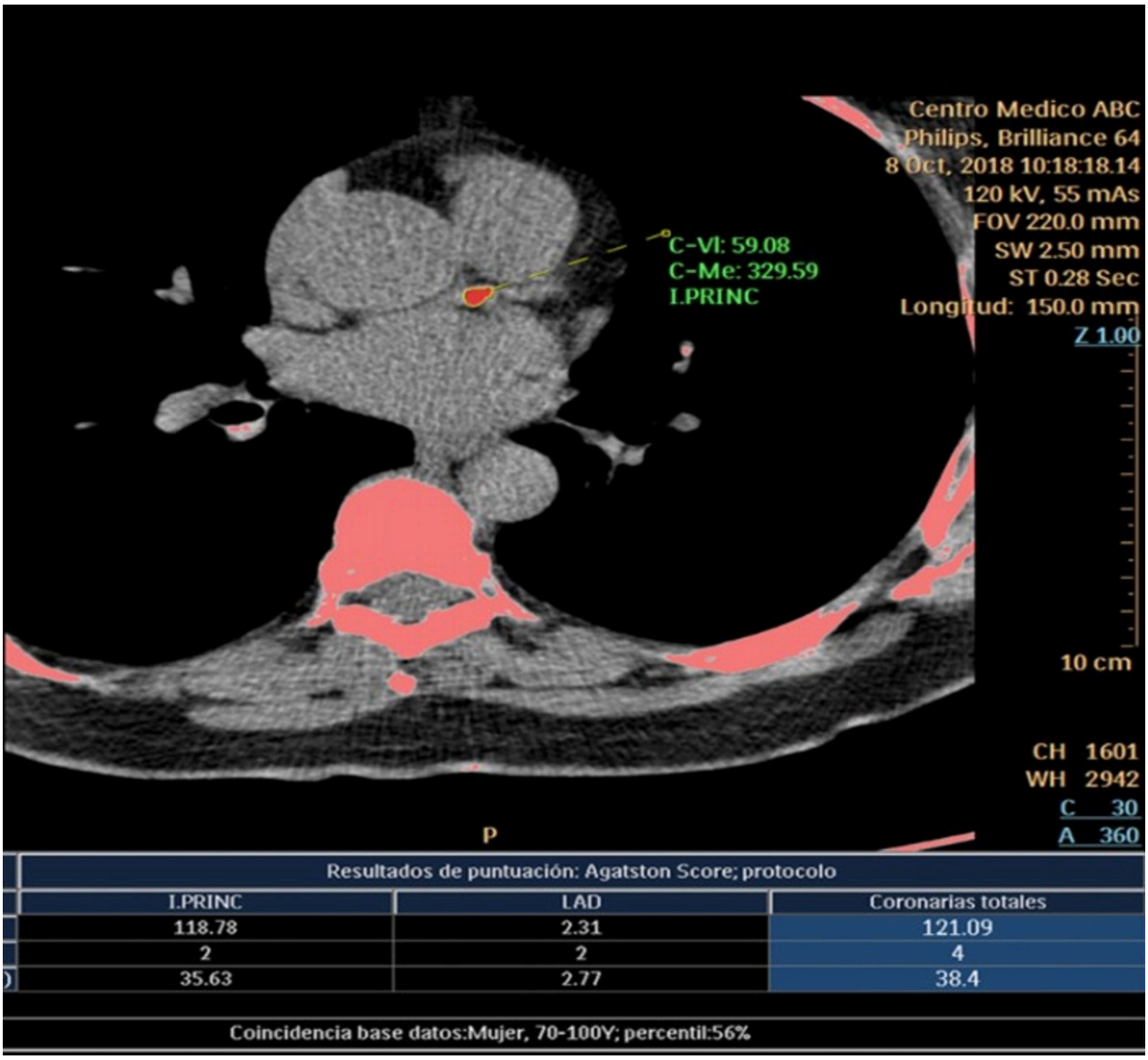


Fig. 1: Asymptomatic patient with an Agatston calcium score of 121, which corresponds to a mild grade of coronary artery disease.

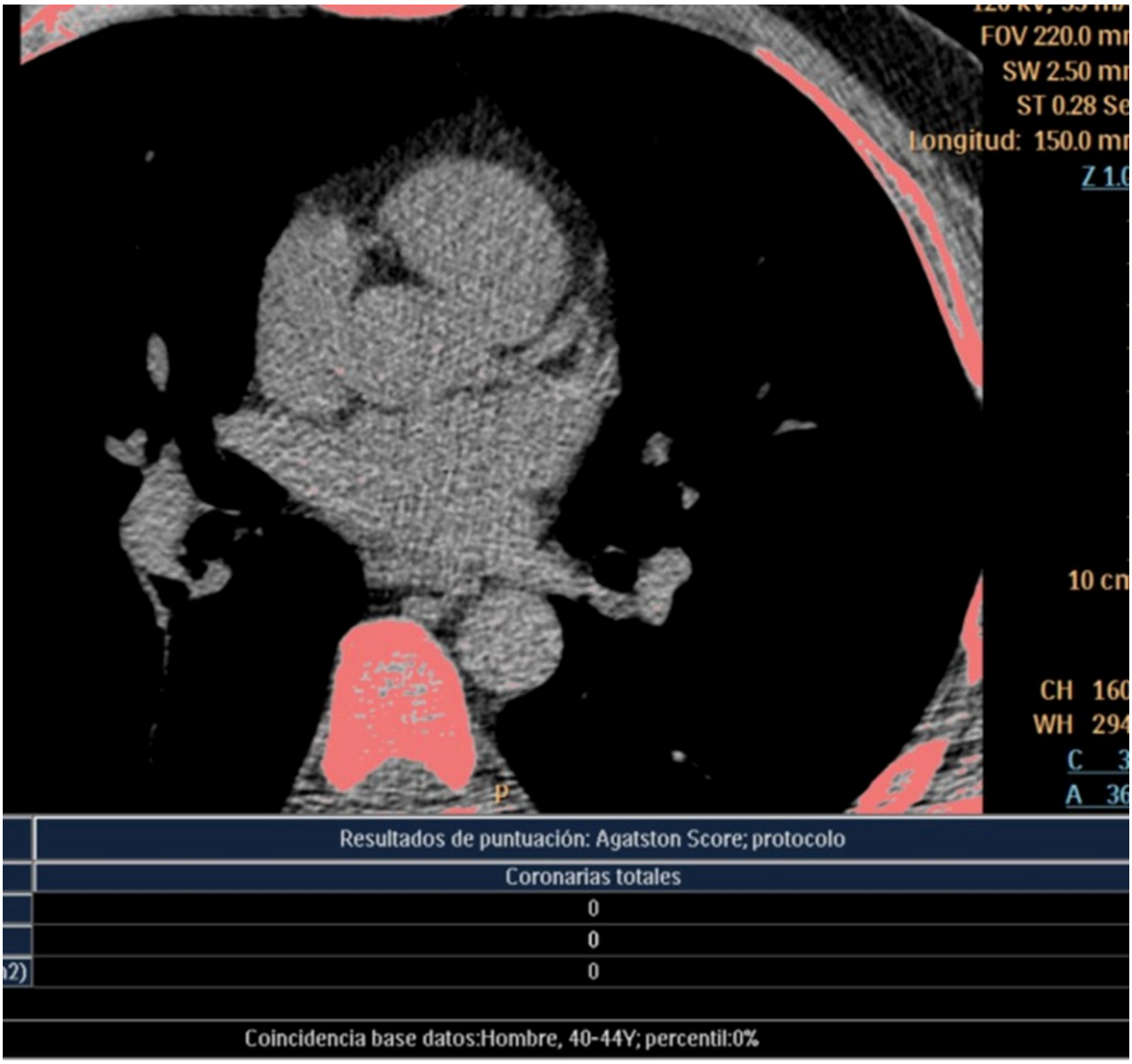
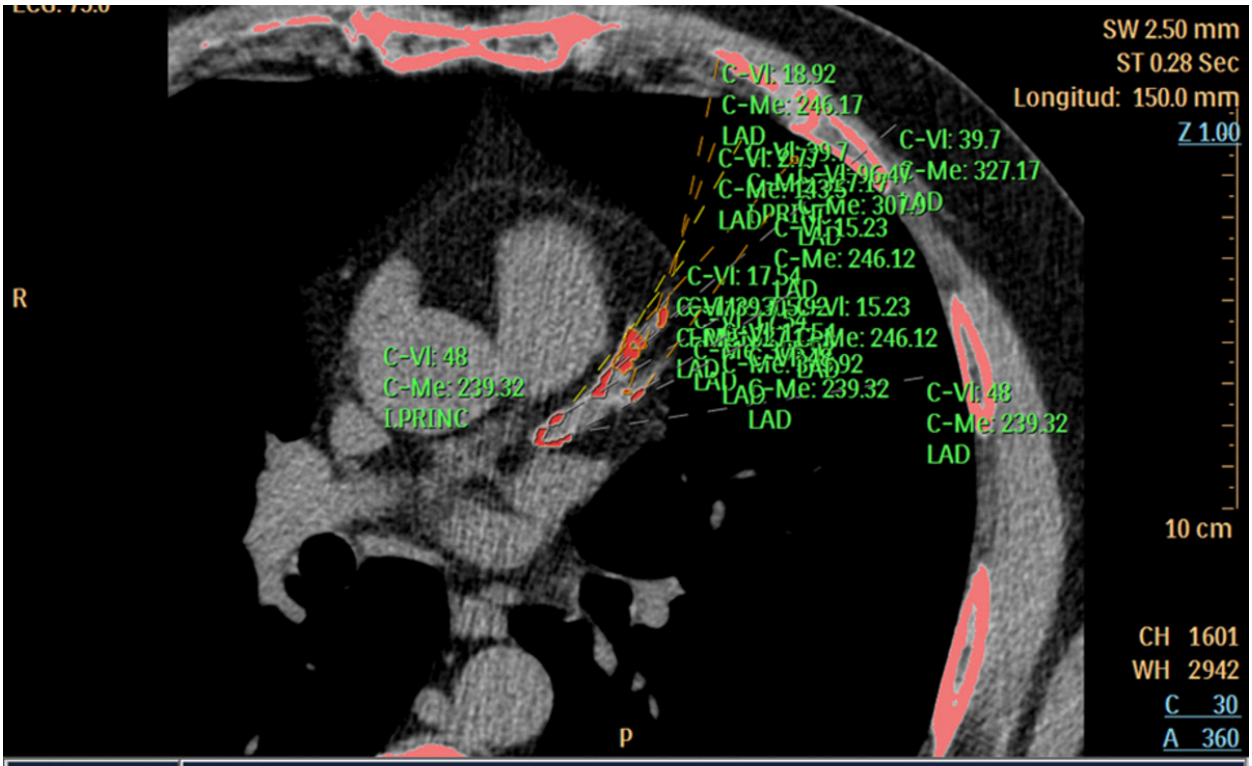


Fig. 2: Asymptomatic patient with an Agatston calcium score of zero, which shows no evidence of coronary artery disease by this method.



	Resultados de puntuación: Agatston Score; protocolo					
	I.PRINC	LAD	LCX	RCA	Coronarias total...	Aorta
Puntuación	218.79	700.52	48	316.03	1283.34	71.08
Nº de ROI	5	28	9	19	61	3
Área cuad. (mm2)	67.58	230.97	21.23	118.72	438.5	21.6

Coincidencia base datos:Hombre, 65-69Y; percentil:93%

Fig. 3: Patient with an Agatston calcium score of 1283.34, which corresponds to severe grade of coronary artery disease by this method.

Results

By segmenting our sample in male and female patients, the correlation between Agatston calcium score and ACC/AHA ASCVD algorithm was mild with an R-value of 0.36 (p-value < 0.001) for the female patients, whereas the male population had an R-value of 0.39 (p-value< 0.001)

The correlation between Agatston calcium score and the Framingham score is mild for both female and male patients with an R-value of 0.37 (p-value<0.00) and 0.35 (p-value <0.00), respectively.

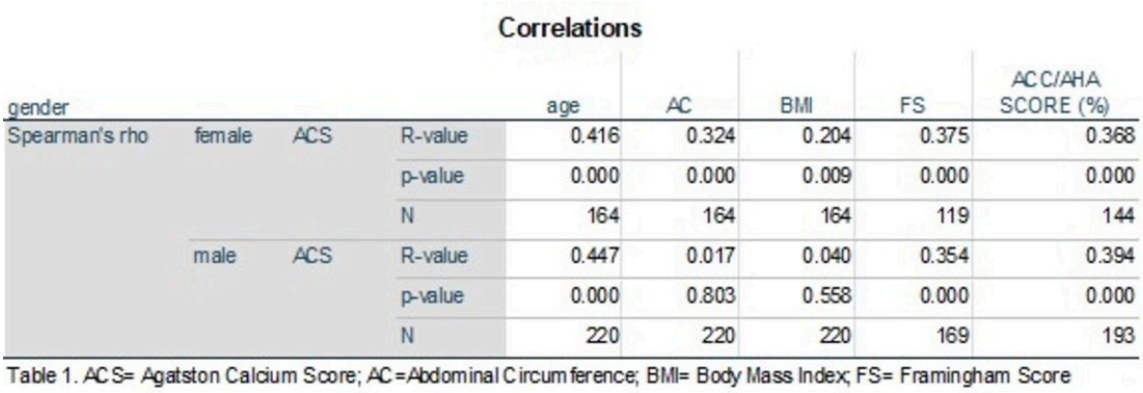
Body mass index has a mild correlation with the Agatston calcium score with an R-value of 0.2 (p-value<0.01) for the female patients, whereas the male patients had a non-statistically significant R- value of 0.04 (p-value of 0.5).

The correlation between Agatston calcium score and abdominal circumference is very low and non-statistically significant for the male population with an R-value of 0.017 (p-value of 0.8), whereas in the female population there was a mild correlation with an R-value of 0.32 (p<0.01), which is statistically significant.

The Agatston calcium score has a mild positive correlation with age by having an R-value of 0.41 for the female patients (p-value< 0.001), meanwhile the Agatston calcium score also had a mild positive correlation with age with an R-value of 0.44 (p-value< 0.001) in the male patient group.

The ANOVA test showed a significant difference between the calcium score variances determined by different groups of age (F-value=8.254; p<0.001), nonetheless age only predicted 8% determined by Eta squared (p<0.01).

Images for this section:



Correlations

gender				age	AC	BMI	FS	ACC/AHA SCORE (%)
Spearman's rho	female	ACS	R-value	0.416	0.324	0.204	0.375	0.368
			p-value	0.000	0.000	0.009	0.000	0.000
			N	164	164	164	119	144
	male	ACS	R-value	0.447	0.017	0.040	0.354	0.394
			p-value	0.000	0.803	0.558	0.000	0.000
			N	220	220	220	169	193

Table 1. ACS= Agatston Calcium Score; AC=Abdominal Circumference; BMI= Body Mass Index; FS= Framingham Score

Table 1: Correlation table between Agatston calcium score and different variables such as the ACSVD risk algorithm, Framingham score, abdominal circumference, body mass index and age.

Conclusion

The correlation between Agatston Calcium Score and clinical cardiovascular assessment methods such as the Framingham risk score and the ACC/ AHA risk algorithm is mild. It is important to consider the Agatston Calcium Score and the cardiovascular risk scores as complements of each other and not as substitutes.

Anthropometric measures such as body mass index and abdominal circumference have a very low correlation with the Agatston calcium score in female patients, therefore, we do not encourage further analysis. In the case of our male patients we did not achieve a representative sample for a statistically significant result.

In the case of age, it has a mild correlation with the Agatston calcium score, nonetheless, it was already noted in previous studies[4].

One major field of oportunity that must be exploited is the ability of calcium scoring to reclassify asymptomatic patients with intermediate risk scores determined by clinical cardiovascular risk tools, in order to tailor statin drug therapy. Our next step is to determine how many patients can be reclassified in higher or lower cardiovascular risk cathegories using the CAC-DRS and AHA recommendations published in 2018. We are looking forward for our future results.

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