Usefulness of calcium score and computed tomography images in patients with nonspecific chest pain: A case report

Utilidad del calcio score e imágenes de tomografía computarizada en pacientes con dolor torácico inespecífico: A propósito de un caso clínico

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Abstract

Coronary calcium is a marker of the presence and extent of atherosclerosis, capable of providing prognostic information in addition to traditional risk factors. Additionally, the coronary calcium test has as an associated descriptor the calcium score or calcium score (Cs) which is useful, mainly, for the risk stratification of asymptomatic patients, whereas in patients with acute or chronic chest pain, it is required, usually, coronary axial computed tomography. In this article, we present the clinical case of a 59-year-old male patient with a history of chronic hypertension and mixed hyperlipidemia who consults for presenting non-specific chest discomfort, without irradiation, of 3 months of evolution, which has been progressively increasing and exacerbated with intense effort; while it improves with rest. No abnormalities suggestive of myocardial ischemia was observed on the 12-lead surface electrocardiogram. A quantification of the Cs is performed, which reports a total value of 350 Hounsfield units (HU) equivalent to acute coronary disease. Due to the high volume, mass and concentration of calcium in a single artery, located at 310 HU in the right descending coronary artery (ADA), together with the clinical and risk factors, it was decided to perform a cardiac catheterization with a finding of 90 % in the proximal segment of the ADA, followed by the respective coronary angioplasty and coronary stent implantation processes.

Keywords: Calcium score; coronary artery; cardiac catheterization; angioplasty; coronary stent

Resumen

El calcio coronario es un marcador de la presencia y la extensión de aterosclerosis, capaz de proporcionar una información pronóstica añadida a los factores de riesgo tradicionales. Adicionalmente, la prueba de calcio coronario tiene como descriptor asociado la puntuación de calcio o calcio score (Cs) el cual es útil, principalmente, para la estratificación de riesgo de pacientes asintomáticos, mientras que en pacientes con dolor agudo o crónico de pecho se requiere, usualmente, la tomografía computarizada axial de coronarias. En este artículo, se presenta el caso clínico de un paciente masculino de 59 años con antecedentes de hipertensión crónica e hiperlipidemia mixta quien consulta por presentar molestia torácica inespecífica, sin irradiación, de 3 meses de evolución, que ha ido aumentando progresivamente y que se exacerba con el esfuerzo intenso; mientras que mejora con el reposo. En el electrocardiograma de superficie de 12 derivaciones no se observaron alteraciones sugerentes de isquemia miocárdica. Se realiza cuantificación del Cs el cual reporta un valor total de 350 unidades Hounsfield (UH) equivalente a enfermedad coronaria aguda. Debido al alto volumen, masa y concentración de calcio en una sola arteria, ubicado en 310 UH en la arteria coronaria descendente derecha (ADA), aunado a la clínica y factores de riesgo, se decidió practicarle un cateterismo cardiaco con hallazgo de lesión de 90% en el segmento proximal de la ADA; seguido de los respectivos procesos de angioplastia coronaria e implante del stent coronario.

Palabras clave: Calcio score; arteria coronaria; cateterismo cardiaco; angioplastia; stent coronario.

Global context.

One of the most interesting applications of multislice computed tomography (MSCT) is the quantitative evaluation of calcium in the coronary arteries[1]. It is a technique used to scan the presence of calcification in the coronary arteries, which is an evident manifestation of arteriosclerosis[2].

When calcium is detected in the coronary arteries, it is compared with reference standards according to age and gender. Unlike other cardiac evaluation medical studies, this method is fast, painless, and noninvasive. It reflects the set of factors that have led to the establishment of coronary artery disease. It is applied quickly and does not require special patient preparation[3].

While the stress test is normally positive with 60% stenosis, detection by MSCT of coronary disease can be performed at an earlier stage[4]. Currently, the greatest utility is to perform follow-up studies to determine the progress of the disease and determine if medical intervention (for example, diet, medication, etc.) is useful in reducing the risk of a cardiac event. Follow-up time is variable, but most centers recommend a follow-up study at 3 years[5,6].

Calcium quantification is based on an algorithm where a density of 130 Hounsfield units is selected as positive in the topography of each of the main coronary segments (trunk of the left coronary artery, left anterior descending coronary artery, artery circumflex coronary artery and right coronary artery)[5]. The score is computed by measuring the volume of coronary calcification and multiplying it by a factor based on the value of the lesion's peak attenuation. According to the information presented in Table 1, the classification is divided into five calcification categories: unidentified, minimum, mild, moderate and significant[7].

Table 1. Classification and clinical significance of coronary heart disease.

Calcium quantification	Calcification level	Clinical meaning
0	Unidentified	Disease exclusion
1 to 10	Minimum	Unlikely stenosis
11 to 100	Mild	Possible risk coronary heart disease
101 to 400	Moderate	Coronary disease with stenosis
> 400	Significant	High probability of significant stenosis

Additionally, although the death rate from ischemic heart disease has declined in the past four decades in developed countries, it remains the cause of approximately one-third of all deaths in subjects over 35 years. It has been estimated that nearly half of middle-aged men and one-third of middle-aged women in the United States will experience some form of ischemic heart disease.

Cardiovascular disease is estimated to cause a total of 4 million deaths each year in Europe and 1.9 million in the European Union, most of it from coronary heart disease (CD), accounting for 47% of all deaths in Europe and 40% of the European Union. This entails an estimated total cost of cardiovascular disease in Europe of 196,000 million euros per year, approximately 54% of the total investment in health, and results in 24% of productivity losses. CD not only affects developed countries; statistics indicate that the impact of this disease is increasing in non-western countries. It has been estimated that, currently, approximately 15.4 million people over the age of 20 in the United States suffer from ischemic heart disease. This corresponds to the total prevalence of CD among those over 20 years of 6.4% (7.9% of men and 5.1% of women)[8].

Regarding myocardial infarction, the prevalence rate is estimated at 2.9% (4.2% of men and 2.1% of women). The incidence of CD in general has decreased in the last decades in the United States between 114 and 133 cases for every 100,000 person-years of follow-up. The decrease has been even greater in cardiovascular disease in general (from 294 to 225 cases per 100,000 person-years). Even so, it is estimated that during 2013 every 44 seconds, some citizen of the United States will suffer myocardial infarction[8].

Only 50% of patients who experience an acute myocardial infarction have a history of acute coronary disease ACD[9]. Furthermore, around 80% of ACD mortality in patients younger than 65 years occurs during the first acute coronary episode. Traditional ACD risk factors predict only 60% of patients who will eventually die of coronary heart disease[9,10]. Approximately one third of individuals who die suddenly from acute coronary heart disease do not have a risk factor for the Framingham index[11]. Even though traditional risk factors such as smoking, age, hyperlipemia, diabetes mellitus, among others, are associated with an increased risk of developing ACD, screening for these traditional factors usually underestimates the risk of sudden cardiac death[12].

Calcium quantification

The presence and the amount of coronary artery calcification, correlates well with the severity of arteriosclerotic process[13,14]. The individual risk of ACD, manifested as an acute cardiac event, increases as the total quantification of coronary calcium increases[15,16]. Additionally, intravascular ultrasound has shown that the absence of coronary calcium is associated with the lack of coronary arteriosclerotic plaque or the presence of minimal plaque[17].

Despite the fact that acute coronary events can occur in the absence of coronary calcification, this factor correlates well with the non-appearance of hemodynamically significant coronary stenosis[9,18]. In fact, the lack of coronary calcium implies a low probability of a major cardiac event in the next two to five years (5% -10% risk)[19-21]. The presence of a high calcium score correlates with an increased risk of presenting a lesion with significant coronary stenosis, particularly in patients with multiple vessel diseases. However, coronary calcification does not identify the specific site of the stenosis.

With the information available at the Bethesda conference, in images of coronary arteriosclerosis, it was concluded that, for this moment, the quantification of coronary calcium by MSCT was the most accurate method for its early detection[22]. The amount of coronary calcium is correlated with the total amount of calcified and non-calcified coronary plaque, as has been determined in post-mortem studies[23].

The use of age and sex adjusted percentiles (quartiles) discriminated the risk status of acute events better than the absolute calcium score values. When evaluating a calcium score test result for a patient, it is important to place the value in the context of the patient's age and condition. A value of 150 is the average for a 70-year-old man, but it is the 90th percentile for a 40-year-old woman.

The correlation between the calcium score and the plaque is identical in men and women; however, just as the clinical manifestations of coronary heart disease are later in women, so is the development of coronary calcium.

Finally, when a patient has an age-gender calcium score that is inappropriate for their age and gender and this value is not in the range of important positive values for the test, it indicates to the patient that, although not at imminent risk, their progression Cardiovascular disease is 75% or 90% higher than that of the general population and, therefore, you must take care of your diet, exercise and avoid consuming saturated fat[24].

Case presentation

Physical examination results

This is a 59-year-old male patient, a farmer by trade, who went to the external cardiology consultation service, for presenting non-specific chest discomfort that has been progressively increasing, 3 months in evolution, without irradiation, which is exacerbated with effort intense and improves with rest, approximately 5 minutes long, non-disabling, without other concomitants, repeatedly treated as a musculoskeletal condition with anti-inflammatory pain relievers. With no history of hospitalization, he reported irregularly controlled arterial hypertension for 10 years and mixed hyperlipidemia on several occasions.

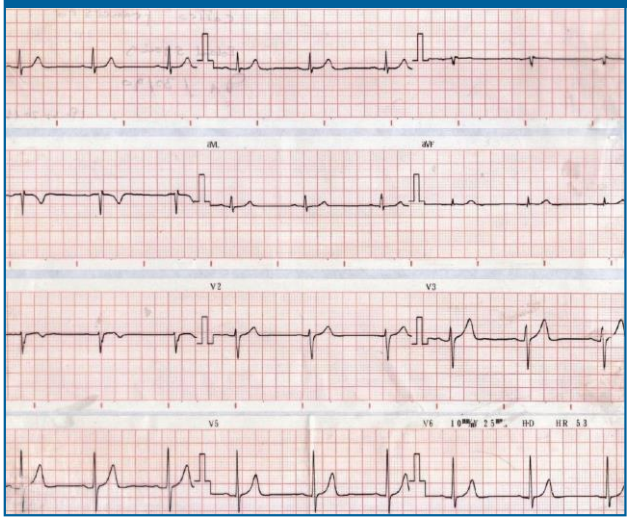
Physical examination showed no signs of musculoskeletal abnormalities, cardiac auscultation within normal range, slightly increased blood pressure of 140/85 mmHg with a heart rate (and radial pulse) of 78 bpm and a body mass index (BMI) of 27 Kg/m^2. The rest of the physical examination was within normal values.

Diagnosis and management

Due to the unspecific nature of the clinical picture and being an intermediate risk patient for coronary artery disease, 12-lead surface electrocardiogram and coronary calcium quantification (Calcium Score) are indicated. A normal 12-lead surface electrocardiogram shows a normal trace, without alterations suggestive of myocardial ischemia (see Figure 1). The electrocardiogram has a sensitivity test of 49% and a specificity that is close to 92%.

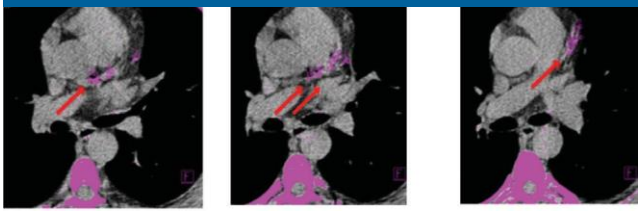
Approximately 40% of patients with chest pain have a normal path; another group presents changes in the ST and in the T wave. 50% of acute infarctions raise the ST, and in 20% it is normal or non-diagnostic.

Figure 1. Patient electrocardiogram.



For the quantification of the calcium score, a total value of 350 UH is reported (Moderate calcification; High risk; 101–400 or >75% percentile; equivalent to EAC (> 20% risk at 10 years on the Framingham scale). Additionally, through a MSCT study, the presence of calcifications that affect the ADA was evidenced, as shown in Figure 2.

Figure 2. Cardiac MSCT images. The red arrows, in the middle of images, show the ADA calcification.



After confirming the presence of coronary heart disease and due to the high volume, mass, and concentration of calcium in a single artery (310 UH in ADA), added to the symptoms and risk factors, cardiac catheterization was performed with the finding of a 90% injury in ADA proximal segment, good distal vessel (see left and center images, in Figure 6). For this reason, the coronary angioplasty and coronary stent implantation processes were carried out, which were carried out successfully (see right image in Figure 6). It is important to note that since the procedure was carried out to date, the patient remains asymptomatic.

Figure 3. Coronary angiographic images. Left and center images show the ADA stenosis disease, while right image was obtained after stent process.

Approximately half of acute myocardial infarctions occur in patients with no history of coronary heart disease (CD), and two thirds are due to thrombosis of soft atherosclerotic plaque with moderate coronary stenosis. Therefore, noninvasive detection and the anticipated form of coronary heart disease is an important means of identifying patients at high risk of acute coronary events[25].

The existence of a relationship between coronary artery disease in an asymptomatic patient (subclinical disease) and symptomatic coronary disease (clinical disease) marked by the extension of calcium in the coronary arteries (CAC), is decisively related to mural atheromatous plaque, being Cs is a tool to identify early subclinical coronary disease and correlate with the total magnitude of the atherosclerotic burden of the coronary plaques. This is an especially important fact since calcification of the coronary arteries correlates with the risk of potential coronary events in the near future.

Clinical evidence demonstrates that the assessment of coronary calcium load by means of the MSCT correlates adequately with the histological analysis of the plaque, and that the CAC measurements reflect the severity of coronary disease and are useful in determining the individual risk of subclinical disease. Quantification of coronary artery calcium is an independent predictor of coronary events in this heart disease, and coronary artery calcification should be considered as a predictor of heart attack as an independent risk factor[26].

MSCT examination of the coronary arteries is an excellent tool to show and quantify the calcium in the coronary arteries. This is an important means of cardiovascular risk assessment with direct clinical uses, as well as being particularly useful in evaluating the percentage of cardiovascular risk of Framingham[27].

Combining the information from the CAC assessment with the information from conventional risk factors can change the percentage of the risk of a coronary event in ischemic heart muscle disease[28].

There is significant evidence from clinical studies that MDCT calcium measurements correlate well with plaque histology, and that CAC measurements accurately reflect the severity of coronary heart disease and may be useful in determining individual risk for future cardiac events[29].

These situations make it possible to include CAC detection as a diagnostic test for ischemic heart disease, to identify patients who can benefit from more intensive risk reduction therapies, independent of predicted clinical picture[30].

Coronary calcium in asymptomatic patients with moderate cardiovascular risk generally adds significant information to the risk factors for the development of symptomatic coronary artery disease[31]. Calcium cannot be used to reliably identify plaques at risk of complications such as rupture or erosion with subsequent thrombus formation. However, the data that is accumulating today indicates that calcium is an indicator of atherosclerotic activity in coronary heart disease.

A negative result of the coronary calcium examination has a high negative predictive value, indicating the absence of significant coronary artery disease and an excellent medium-term prognosis[32].

The results of negative calcium assessments (without calcium) of the coronary artery indicate a very low short-term risk of sudden cardiac death, even in the presence of other risk factors such as diabetes mellitus, a high calcium count in the coronary arteries more accurately predicting coronary heart disease risk in high-risk adults, we now need to determine whether the addition of this test to the management of these patients would change the treatment, improving short and long-term results and that this is cost / effective[33].

The investigation is an extremely sensitive assessment to predict stenotic disease of calcium. The analysis by coronary arterial territories, the sensitivity and the negative predictive value of coronary arterial calcification by means of MSCT is high[34].

In conclusion, an emerging consensus seems to indicate that coronary calcium assessment screening, in combination with MSCT images, may be a useful clinical tool in patients at intermediate risk for coronary events based on risk determined based only on conventional risk factors with a negative predictive value of 99.7%.

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