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(RESEARCH ARTICLE)

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Agastaton coronary artery calcium score distribution by age and gender among 20-80 years old patients—data from a single center in Pakistan

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Abstract

Purpose: Coronary artery calcium (CAC) is an estimate of atherosclerotic burden and well-validated for risk assessment in middle to older aged adults. The coronary artery calcium (CAC) score is used in decision making for preventive medications in patients with borderline clinical risk scores. This study will be valuable addition to research data base as no such study has been conducted in our center to date.

Methods: A retrospective study was conducted at Rawalpindi institute of cardiology and database was screened for patients who underwent CT cardiac angiography and calcium score assessment between January 2024 and June 2024. Study population included 500 patients. The absolute Agastaton calcium scores (zero, mild, moderate and severe) for age and gender were tabulated and statistical analysis was done to find mean age and prevalent gender for each category of calcium score.

Results: Data of 500 patients was scrutinized. Of these, 183 patients were excluded due to revascularization (CABG or stents) or due to incomplete clinical information. Out of remaining 317patients, 180 were males and 137 were females.

- Zero calcium score was found in 146 patients. Mean age was 47 years and M>F.
- Mild calcium score was found in 76 patients. Mean age was 53 years and M>F.
- Moderate calcium score was found in 62 patients. Mean age was 55 years and M>F.
- Severe calcium score was found in 33 patients. Mean age was 62 years and M>F.

Conclusion: In this study CAC scores were provided for men and women, with their mean age; which is helpful in therapeutic decision-making. Non-zero CAC score corresponded to more than half of population, with all categories more prevalent in males. As an approximate rule of thumb, there is direct relation in mean age with increase in the severity category of calcium score.

Keywords: Coronary artery; Calcium score; Computed tomography; Agastaton

1. Introduction

Approximately half of all cardiovascular disease (CVD)–related deaths has no prior cardiac symptoms or diagnoses (1). CT scan for coronary artery calcium (CAC) is an important tool in cardiovascular risk assessment and selection of appropriate preventive therapy in patients with intermediate or unclear CVD risk (2, 3).

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1.1. Pathophysiology of CAD

Coronary artery disease is typically caused by atheromatous narrowing of the vessel resulting in blockage. A mature plaque has two components; macrophages and smooth muscle cells. The necrotic "foam cells" - monocyte-derived macrophages that infiltrate into the intima and absorb lipids - are the primary source of the lipid core. Smooth muscle cells migrate in the vascular wall from the media into the intima, where they multiply to create a fibrous capsule around the lipid core, forming the connective tissue matrix .Calcification of the coronary arteries occurs along with the progression of severe atherosclerosis. Coronary artery stenosis of more than 50% or a reduction in diameter area by 80% usually leads to angina on exertion. Occlusion is near total in acute myocardial infarction than unstable angina, where arterial occlusion is frequently partial. Acute coronary events usually occur when a plaque ruptures and activates the formation of a thrombus (4).Fig 1.

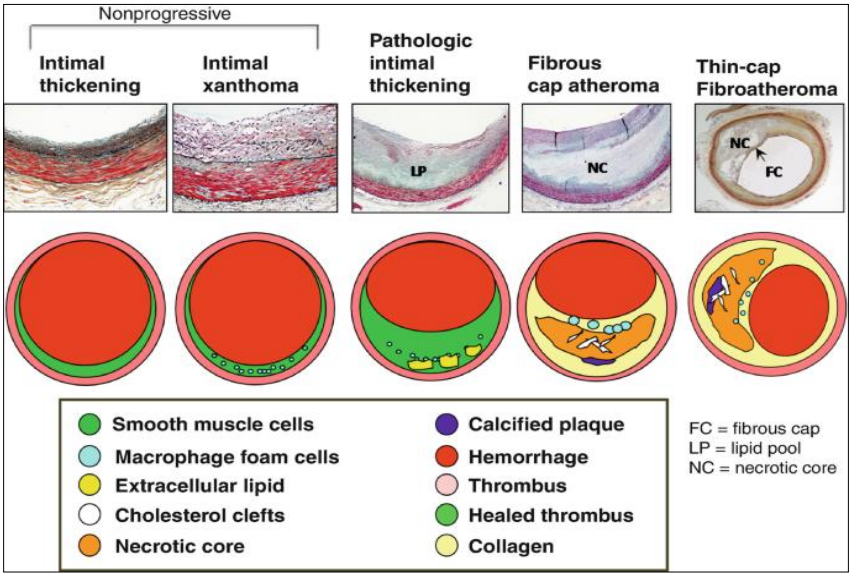

Figure 1 Pathophysiology of coronary artery plaque formation

2. Methods

A retrospective study was conducted at Rawalpindi institute of cardiology and database was screened for patients who underwent CT cardiac angiography and calcium score assessment between January 2024 and June 2024.

2.1. Ethical approval

The study was performed according to the Declaration of Helsinki principles. Informed consent was waived off, as the study was conducted retrospectively with the use of the hospital database.

2.2. Study population

The authors of the study screened data of 500 patients who underwent computed tomography coronary angiography (CTCA) and CAC score calculation, between January 01, 2024 and June 30, 2024, in the radiology department of Rawalpindi Institute of Cardiology, Pakistan.

The exclusion criteria were

- Patients with a coronary stent or bypass graft
- Patients with missing information regarding history of revascularization or calcium scores.

Of the 500 patients, 183 were excluded; finally, the study population included 317 participants. Among the study population (n = 500), 287 had received both CAC scoring and CTA, and 30 patients had received CAC scoring alone.

2.3. Coronary Computed Tomography Angiography and Coronary Artery Calcium Score Calculation

Coronary CTAs and CAC score calculations were performed on a 640-detector CT scanner (Toshiba Aquillion One). A beta-blocker was given to patients with a heart rate of >65 bpm at least one hour before coronary CTA under cardiologist's supervision. Scan was electrocardiographically triggered at 60%–80% of the R-R interval. Retrospective ECG gating was performed in patients with high heart rates for CTA, and prospective ECG-triggered CT acquisition was used for CAC scoring. Before injection of contrast, non-enhanced images for CAC scoring were obtained. Intravenous iodinated contrast was injected at a rate of 4–6 mL/sec, followed by saline infusion. Standard parameters for CTA and CAC were used. The CAC was described as a plaque of at least three contiguous pixels with an attenuation of ≥130 Hounsfield units. The Vscore (Toshiba Aquillion One) software system was used for image post-processing, and the CAC score was calculated using the Agastaton method.

Table 1 Classification of coronary calcium absolute content evaluated by cardiac CT and quantified by Agastaton units

Absolute value (agastaton units)	Ranking
0	Absent
>0<10	Minimal
≥10<100	Mild
≥100<400	Moderate
≥400<1000	Severe
>1000	Extensive

2.4. Statistical analysis

The absolute Agastaton calcium scores (zero, mild, moderate and severe--examples Fig 2-5) for age and gender were tabulated and statistical analysis was done to find mean age and prevalent gender for each category of calcium score, Table 1.

3. Results

Data of 500 patients was scrutinized. Of these, 183 patients were excluded due to revascularization (CABG or stents) or due to incomplete clinical information. Out of remaining 317patients, 180 were males and 137 were females. Figures 6, 7.

- Zero score was found in 146 patients. Mean age was 47years and M>F.
- Mild calcium score was found in 76 patients. Mean age was 53years and M>F.
- Moderate calcium score was found in 62 patients. Mean age was 55years and M>F.
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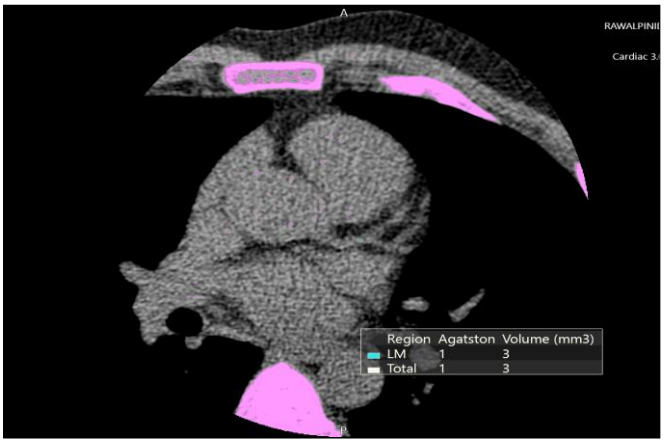

Figure 2 Minimal Agastaton calcium score of 1

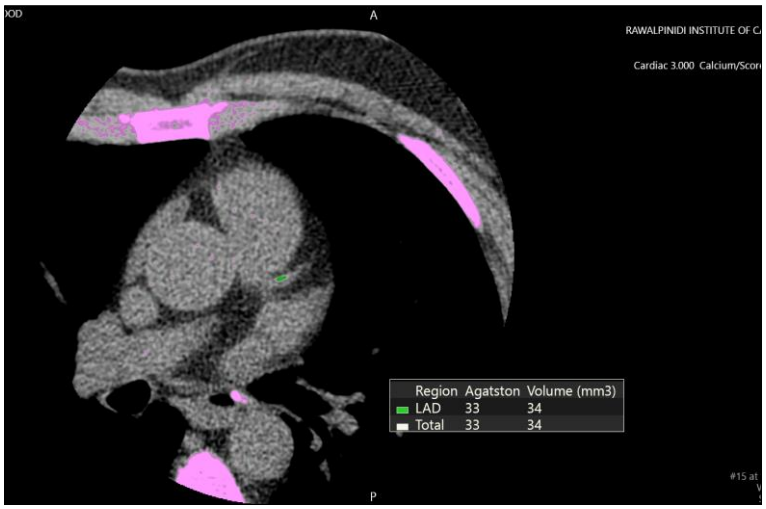

Figure 3 Mild Agastaton calcium score of 33

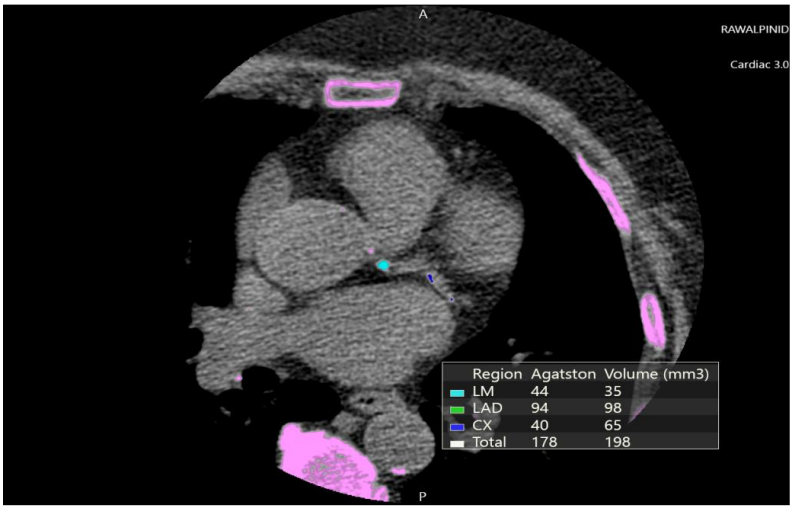

Figure 4 Moderate Agastaton calcium score of 178

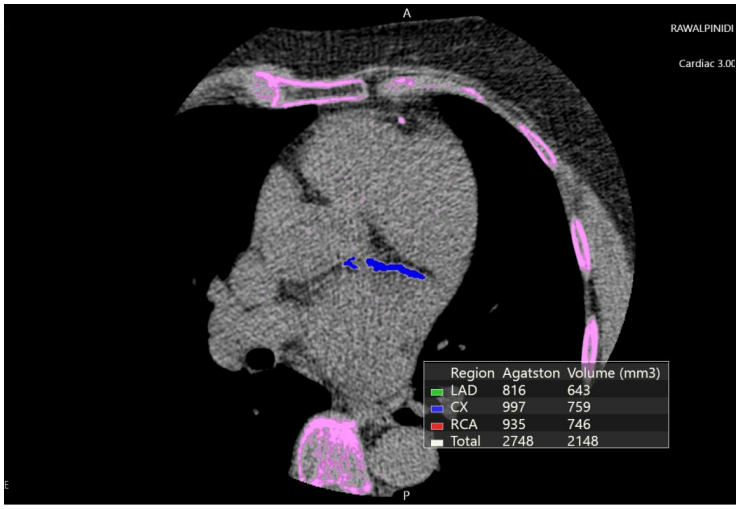

Figure 5 Severe Agastaton calcium score of 2748

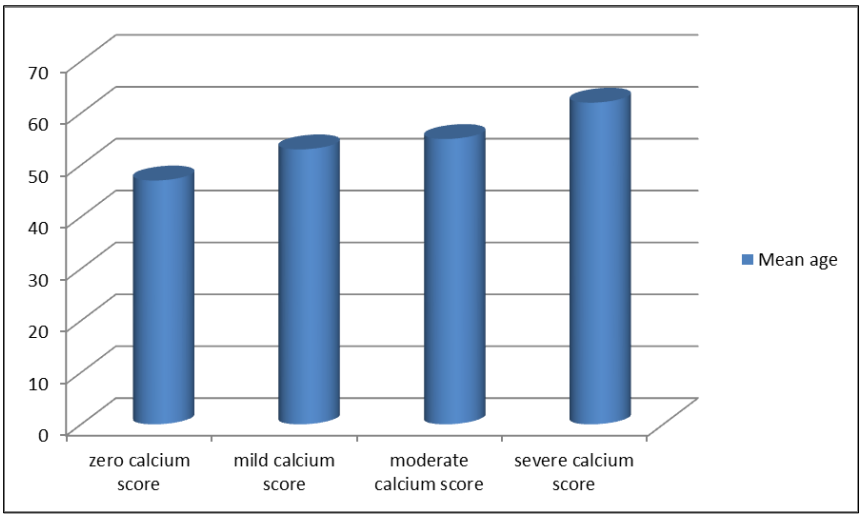

Figure 6 Mean age in each category of calcium score

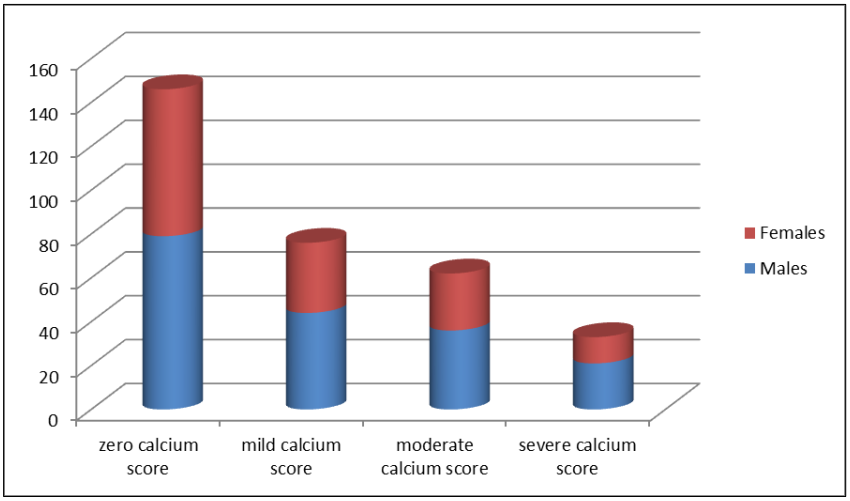

Figure 7 Prevalent gender in each category of calcium score

4. Discussion

Conventionally, CAC was considered as an estimator of the probability of obstructive coronary artery disease and might have resulted directly to cardiac catheterization. It is, however, more specific as a marker of overall atherosclerotic plaque burden (5).

One of the major advantages of CAC is its high negative predictive value for clinically significant coronary artery disease in middle-aged and older individuals who had relatively increased risk estimates from conventional risk scores but were found to be very low risk by using CAC (6). It has also been useful in the identification of covert cardiac disease in younger adults, in whom CAC was incidentally found to be clinically significant, warranting preventive therapy (7). Furthermore, its benefit as a tool for physician-patient mutual decision making is invaluable, as research has shown that patients who understand their CAC score are likely to be more compliant to their medications and lifestyle modifications.

In 2018, the SCCT published the CAC Data and Reporting System (CAC-DRS), a phenomenal approach to reporting CAC that aims to standardize the methods for reporting findings about CAC on all gated cardiac scans and non-gated chest CT scans.The CAC-DRS categories of 0–3 were defined to correlate with the conventional Agastaton score categories of 0 (very low risk), 1–99 (mild CAC, mildly increased risk), 100–299 (moderate CAC, moderately increased risk), and

higher than 300 (moderately to severely increased risk).Visual assessment of CAC on non-gated scans is done with these same categories in mind, with scores of 0–3 corresponding to similar risk categories (8),Table 2.

Table 2 CAC Data and reporting system with treatment recommendation

Cac data and reporting system (cac drs)				
Cac-drs	**Agaston**	**Visual**	**Risk**	**Treatment recommendation**
0	0	0	Very low	Statin not recommended
1	1-99	1	Mildly increased	Moderate intensity statin
2	100-199	2	Moderately increased	Moderate to high intensity statin+81mg aspirin
3	>300	3	Moderatrely to severely increased	High intensity statin+81mg aspirin

5. Conclusion

The coronary arteries calcium score is a reliable predictor of CAD events. It is being widely accepted because of its non-invasiveness and high accuracy in predicting atherosclerotic CAD risk in individuals with low to moderate clinical risk. By publishing this article, we hope that clinicians will be able to use CAC scoring as a valid screening tool for early diagnosis of CAD in patients, allowing them to take the appropriate preventative actions, to decrease CAD-related mortality and morbidity. Additionally, recent developments in the application of artificial intelligence show bright prospects; with the development of CAC CT post-processing algorithms and software to automate the estimation and reporting of CAC.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors have no conflicts of interest to be disclosed.

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

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Author short biography

Author is a lead radiologist working in a tertiary care cardiac center in Rawalpindi, Pakistan. It's a 300 bedded hospital with 24/7 ER services, pediatric and adult cardiology and cardiac surgery services; biggest public sector cardiac center in the region. This center has a well-equipped imaging department with its own 3-Tesla MRI, and 640 slice CT scanners, latest Dopper, echo and x-ray machines. She is fully involved in reporting cardiac CTs and MRIs along with teaching and training of post-graduate trainees, also fulfilling administrative responsibilities of department efficiently. She has attended many National and International conferences and have numerous publications in national and international journals.