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Original Research Article

THE USEFULNESS OF CORONARY CTA IN IDENTIFYING CASES OF CORONARY ARTERY DISEASE

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Abstract: *Ischemic heart disease is the leading cause of mortality worldwide. A complete diagnosis assessment is essential for patients with suspected CAD since it influences many treatment decisions. Invasive coronary angiography is the gold standard for detecting CAD.* ***Objective:*** *To investigate the diagnostic effectiveness of coronary computed tomography angiography (CTA) in diagnosing coronary artery disease.* ***Method:*** *This cross-sectional research comprised 100 patients with suspected coronary artery disease admitted to the Chaudhary Pervez Ellahi Institute of Cardiology Hospital between March 2022 and March 2023. All patients received a coronary CTA and coronary angiography. The findings of the patients' coronary CTAs and coronary angiography were evaluated. The practical uses of coronary CTA in the identification of CAD were investigated, as well as the identification and coincidence frequency of coronary CTA for assessing the degree of coronary stenosis.* ***Results:*** *There were no significant differences between coronary CTAs and coronary angiographies in detecting positive CAD or coronary stenosis. Regarding identifying coronary artery disease, coronary CTA had a sensitivity of 81.69% (58/71) and a specificity of 75.8% (22/29). The positive predictive value was 90.6% (58/64), while the negative predictive value was 62.8% (22/35). The coronary CTA findings revealed that 18 patients had coronary stenosis of no more than 70% and 40 patients had coronary stenosis of more than 70% among the total 58 patients with coronary artery disease that were found using both coronary angiography and coronary CTA. According to the findings of the coronary angiography, there were 37 patients with coronary stenosis greater than 70% and 21 patients with coronary stenosis below seventy percent. P value p=0.326 indicates that no significant differences were detected.* ***Conclusions****: In conclusion, coronary CTA has a beneficial and valuable role in the early detection of CAD. It is non-invasive and simple to use. Furthermore, coronary CTA can precisely find the locations of coronary stenosis and determine the degree of stenosis. As a result, it merits widespread adoption as a CAD screening tool.*

Keywords: Coronary Artery Disease, Coronary Computed Tomography Angiography, Coronary Angiography, Diagnosis

Introduction

Globally, ischemic heart disease continues to be the primary cause of death (1) It is distinguished by a brief and quick myocardial oxygen shortage brought on by coronary stenosis (2). A thorough evaluation of the diagnosis is crucial for those with probable coronary artery disease since it guides a significant number of therapy choices. Invasive coronary angiography is the gold standard for diagnosing coronary artery disease (CAD) (3).
According to research, coronary angiography may effectively represent the degree of coronary stenosis (4). Nevertheless, coronary angiography is an invasive procedure that has a high risk of serious injuries. Additionally, numerous scholars believe that individuals likely to need revascularization should be the only ones with coronary angiography (4). The recommendations suggest that non-invasive ischemia exams be employed as a substitute for invasive coronary angiography for individuals suspected of having CAD and with a low risk of severe coronary stenosis (5). Numerous earlier investigations discovered that the accuracy rate of non-invasive ischemia exams in identifying individuals with CAD is poor (6). With the advancement of multislice computed tomography equipment in recent years, coronary computed tomography angiography (CTA) has given medical professionals a novel and exciting technique for the non-invasive evaluation of CAD (7).
At the moment, coronary CT scans are crucial for rapidly identifying CAD. According to reports, coronary CT scans have limited use in determining the degree of myocardial stenosis and identifying the "criminal" coronary artery branch (8). Results of studies evaluating coronary CTA with coronary angiography are relatively rare, and their conclusions are questionable.
In light of this, the present study compared these two techniques to assist physicians in identifying the approach that is now best suitable for detecting CAD in patients who exhibit symptoms of probable ischemic heart disease.

Methodology

The study group included 100 individuals with probable coronary artery disease hospitalized between March 2023 and March 2023. Our hospital's Research Ethics Committee authorized this cross-sectional investigation. Every patient participating in this study provided informed consent. All of the patients had undergone coronary CTA and angiography. The requirements for inclusion were the following: patients with presumed coronary artery disease, Patients with cardiac function ranging from class I to class II, Individuals with no record of acute myocardial infarction, Individuals who willingly underwent coronary CTA and coronary angiography and agreed with this research, and Individuals with complete clinical information. Criteria for exclusion were outlined as follows (1). Patients who are allergic to iodine; (2) Patients who have significant liver or renal dysfunction; and (3) Patients who have arrhythmia, chronic heart disease, sick sinus syndrome, cognitive impairment, or cancer.

The coronary CTA was carried out, making use of 64-slice CT equipment. Before each assessment, the patient's heart rates were controlled with oral metoprolol to around 60 beats per minute. First, a low-dose non-contrast enhanced scanning was performed to measure and estimate coronary artery calcium. Based on the patient's body routine, the contrast agent was introduced through the antecubital vein at an average flow rate of 5 ml/s, and then saline was flushed. Based on the individual weight of each patient, a peak tube voltage of 100 kV and a tube current of 180 mA were used for the coronary CTA. 350 ms was the gantry rotation duration. The results were retrospectively reconstructed, spanning 70% to 80% of the R-R interval while synchronizing to the ECG. Reconstruction settings for slice thickness, convolution kernel, and field of view were set by standards of clinical practice and the guidelines provided by earlier studies. The pictures were moved to a specially designated external workstation to restore the three-dimensional model of the coronary artery.

The coronary angiographies were carried out using the techniques that earlier researchers had published. Two milliliters of 2% lidocaine were used to provide local anesthesia. Judkins catheters were utilized, and either the radial or femoral artery was punctured. During the coronary angiography procedure, the right and left coronary regions were selectively catheterized using a contrast material injection. Different projections were used to acquire the photos. Typically, it was 2 for the coronary artery on the right side and 4 for the left.

Two board-certified doctors assessed the coronary CTA and coronary angiography results; however, they were not familiar with the fundamental details of the patients in this investigation. Any coronary artery with more than 50% stenosis was regarded as having a positive result. The condition of the coronary artery was evaluated by visually comparing it to the adjacent healthy blood vessels. To verify the effectiveness of coronary CTA in identifying coronary artery disease and the precision of assessing coronary stenosis with varying degrees of severity and establishing the location of the coronary lesions, the results of coronary CTA and coronary angiography were evaluated.

Version 21 of the SPSS program was used to evaluate all the information collected in the research. The measurement results were presented as the mean ± SD, and t-tests were used to compare the two groups.

Both the percentage and the total number of cases were displayed for the count data. Chi-square tests were utilized to compare the two groups. Using the results of coronary angiography as a point of reference, the collected data were utilized to evaluate the effectiveness of coronary CTA in diagnosing coronary artery diseases.

Results

A total of 100 cases were included in our research. Out of 100 cases, probable stable angina was diagnosed in 21% of the cases, while 79% were diagnosed with suspected unstable angina. Most of the participants were male, 63%. The mean age of the participants was 64.6±4.1years. Mean BMI was 23.6±0.6 kg/m^2. 19% of the cases gave a history of smoking, 41% had Diabetes mellitus, 24% had hyperlipidemia, and 51% of the cases were hypertensive (Table 1).

Table 1: Patient demographics

Variable	Results
Total cases	100
Suspicious unstable angina	79 (79)
Suspicious stable angina	21 (21)
Sex	
Male	63 (63)
Female	37 (37)
Mean age (years)	64.6±4.1
BMI (kg/m^2)	23.6±0.6
Smoking history	19 (19)
Diabetes mellitus	41 (41)
Hyperlipemia	24 (24)
Hypertension	51 (51)

The coronary angiography findings revealed that, out of the one hundred individuals with probable angina pectoris, the positive rate was 71.0%, and the negative rate was 29%.

The coronary CTA findings revealed that 65% of patients had CAD and 35% did not. There were no statistically significant differences between the two modalities in diagnosing CAD (p=0.079) (Table 2).

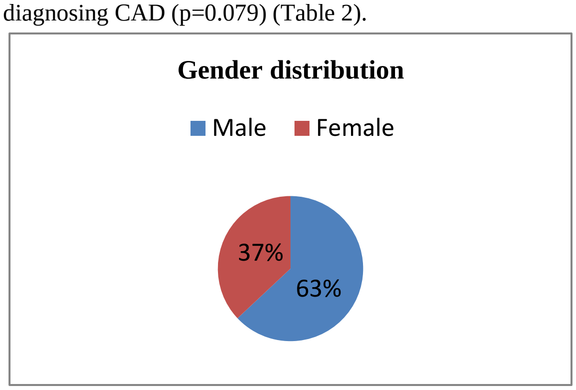

Figure 2: Showing the Gender distribution of the study population.

Table 2: An analysis comparing the positive and negative frequency of coronary artery diseases in coronary CTA and coronary angiography

Variable	Positive frequency N,%	Negative frequency N,%	χ^2 value	P value
Coronary angiography	71 (71)	29 (29)	3.512	0.079
Coronary CTA	65 (65)	35(35)		

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Regarding identifying coronary artery disease, coronary CTA had a sensitivity of 81.69% (58/71) and a specificity of 75.8% (22/29). As can be seen in table 3, the positive predictive value was 90.6% (58/64), while the negative predictive value was 62.8% (22/35).

Table 3: Comparison between coronary CTA and coronary angiography

Coronary CTA	Coronary angiography		Total
	Positive	Negative	
Positive	58	7	64
Negative	13	22	35
Total	71	29	100

The coronary CTA findings revealed that 18 patients had coronary stenosis of no more than 70% and 40 patients had coronary stenosis of more than 70% among the total 58 patients with coronary artery disease that were found using both coronary angiography and coronary CTA. According to the findings of the coronary angiography, 37 patients had coronary stenosis greater than 70%, and 21 patients had coronary stenosis below seventy percent. The p-value of 0.326 indicates that no significant differences were detected.

Table 4: Identification of coronary stenosis in individuals with coronary artery disease

Methods	Coronary stenosis N=58 n,%	
	>70%	<70%
Coronary angiography	21 (36.2)	37 (63.8)
Coronary CTA	18 (31.0)	40 (69)
χ^2 value	0.326	
P value	0.619	

According to the coronary angiography results, thirty-six coronary lesions were located in the LAD, twenty-three in the LCX, and twenty-one in the RCA. Results from the coronary CTA showed that there were 31 localized coronary lesions in the LAD, 18 localized in the LCX, and 23 localized in the RCA.The coincidence rates were 86.1% (31/36) for the LAD disease, 78.2% (18/23) for the LCX disease, and 91.3 (21/23) for the RCA disease.

Table 5: Localization of coronary lesions across coronary angiography and coronary CTA

Location of lesions	Coronary CTA,n	Coronary angiography,n	Coincidence rate
LAD	31	36	86.1
LCX	18	23	78.2
RCA	23	21	91.3

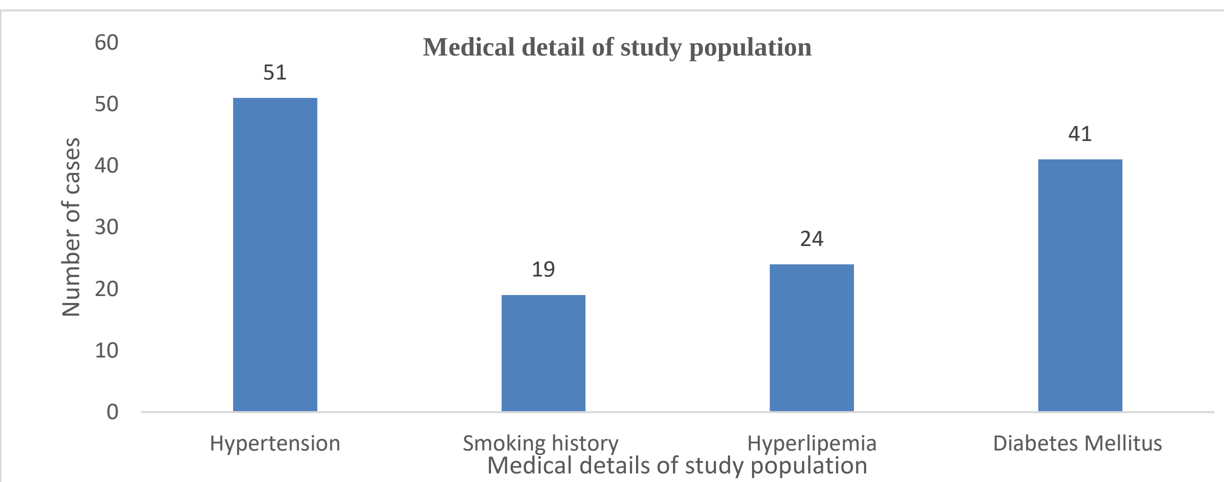

Figure 1: Showing the medical details of the study population

Discussion

Coronary artery disease is one of the worst diseases that pose a substantial risk to patients' physical and mental well-being (9). It is becoming the primary cause of death in both industrialized and developing nations (10). These days, coronary angiography, coronary computed tomography angiography (CTA), and intravascular ultrasonography are among the test methods utilized in healthcare to identify coronary artery disease promptly (11).

Coronary angiography is believed to be the most reliable test for determining and identifying coronary artery disease (12). The coronary angiography test was used as the

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reference in this investigation. Nevertheless, coronary angiography has been reported to cause cardiovascular problems as well as difficulties at the local artery puncture site in actual practice (13) . As a result, patients typically hesitate to consent to this procedure. Patients who have probable coronary artery disease are highly interested in coronary CTA since it is a non-invasive assessment for the diagnosis of coronary artery disease (8).

This study compared the outcomes of coronary CTA with coronary angiography to further support its effectiveness. In this investigation, individuals undergoing coronary CTA and coronary angiography did not experience any problems. According to reports, having fast heartbeats or irregular heart rhythms makes coronary CTA partially contraindicated (14). This investigation used oral metoprolol premedication to regulate each patient's heart rate to a pulse of 60 to get the best possible picture quality. By varying the scanning duration, coronary CTA, instead of coronary angiography, might reveal pulmonary veins or the proper heart anatomy. Furthermore, spiral-mode imaging is frequently used to acquire image data during coronary CTA procedures. According to earlier research findings, the coronary artery reconstructions in this study were carried out between 70% and 80% of the R-R interval, corresponding to mild to late diastole (15).

In terms of identifying coronary artery disease, coronary CTA had a sensitivity of 81.69% (58/71) and a specificity of 75.8% (22/29), the positive predictive value was 90.6% (58/64), while the negative predictive value was 62.8% (22/35). All these results are from the previous studies (8) .

All of these findings suggest that annoying injuries from coronary angiography can be significantly decreased by using coronary CTA, a non-invasive method, for the first testing of patients with probable CAD. The qualitative evaluation of coronary stenosis improves the treatment strategy. According to Griffin et al., coronary CTA's ability to quantify coronary stenosis in an individual segment moderately correlates with coronary angiography (16).

According to another study, coronary CTA has a systematic bias that often overstates the severity of coronary stenosis by 5–10%, particularly for coronary lesions connected to calcified plaques (17). According to reports, Higher calcium scores have been linked to a greater false-positive rate of coronary CTA (18). Furthermore, the picture quality of coronary CTA is often good enough to classify stenosis degrees into more diverse groups (19).

Additionally, it is demonstrated that there were no significant differences between coronary CTA and coronary angiography in terms of detecting the degree of coronary stenosis. The hardening of the coronary arteries and the spatial resolution may be to blame for this (20). These findings match those of Castellano et al. Published (21).

Coronary CTA appears to be the most effective method for identifying CAD in individuals who may be at risk for it. Preventing needless coronary angiography, lowering associated risks, and making the most use of medical resources might all be beneficial.

Nevertheless, this study has many limitations. There was a rather limited sample size. There was no follow-up. The investigation did not provide the findings of the safety assessment or evaluate the prognostic significance of coronary CTA in individuals with CAD.

Conclusion

In conclusion, coronary CTA has a valuable role in the early detection of CAD. It is non-invasive and simple to use. Furthermore, coronary CTA can precisely find the locations of coronary stenosis and determine the degree of stenosis. As a result, it merits widespread adoption as a CAD screening tool.

Declarations

Data Availability statement

All data generated or analyzed during the study are included in the manuscript.

Ethics approval and consent to participate

Approved by the department concerned. (No.IRB.CPEIC-2022-01-3/36)

Consent for publication

Approved

Funding

Not applicable

Conflict of interest

The authors declared the absence of a conflict of interest.

Author Contribution

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Study Design, Review of Literature.

Conception of Study, Development of Research Methodology Design, Study Design, Review of manuscript, final approval of manuscript.

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Conception of Study, Final approval of manuscript.

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Manuscript revisions, critical input.

Coordination of collaborative efforts.

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Manuscript drafting.

Data entry and data analysis, as well as drafting the article.

References

1. Dai H, Much AA, Maor E, Asher E, Younis A, Xu Y, et al. Global, regional, and national burden of ischaemic heart disease and its attributable risk factors, 1990–2017: results from the Global Burden of Disease Study 2017. European Heart Journal-Quality of Care and Clinical Outcomes. 2022;8(1):50-60.
2. Singh AK, Jat RK. Myocardial Infarction. Himalayan Journal of Health Sciences. 2021:16-32.
3. Kosyakovsky LB, Austin PC, Ross HJ, Wang X, Abdel-Qadir H, Goodman SG, et al. Early invasive coronary angiography and acute ischaemic heart failure outcomes. European heart journal. 2021;42(36):3756-66.
4. Miller RJ, Bonow RO, Gransar H, Park R, Slomka PJ, Friedman JD, et al. Percutaneous or surgical revascularization is associated with survival benefit in stable coronary artery disease. European Heart Journal-Cardiovascular Imaging. 2020;21(9):961-70.

5. Jensen JM, Bøtker HE, Mathiassen ON, Grove EL, Øvrehus KA, Pedersen KB, et al. Computed tomography derived fractional flow reserve testing in stable patients with typical angina pectoris: influence on downstream rate of invasive coronary angiography. European Heart Journal-Cardiovascular Imaging. 2018;19(4):405-14.
6. J. Robbins M, Christia P, Sanz J. Non-invasive assessment of the coronary arteries in the era of the ISCHEMIA trial. SN Comprehensive Clinical Medicine. 2022;4(1):164.
7. Sandstedt M. Computed Tomography of the Coronary Arteries: Developmental and Prognostic Investigations: Linköping University Electronic Press; 2020.
8. Ru L, Lan P, Xu C, Lu L, Chen T. The value of coronary CTA in the diagnosis of coronary artery disease. American Journal of Translational Research. 2021;13(5):5287.
9. Vos J. Cardiovascular disease and meaning in life: A systematic literature review and conceptual model. Palliative & Supportive Care. 2021;19(3):367-76.
10. Nowbar AN, Gitto M, Howard JP, Francis DP, Al-Lamee R. Mortality from ischemic heart disease: Analysis of data from the World Health Organization and coronary artery disease risk factors From NCD Risk Factor Collaboration. Circulation: cardiovascular quality and outcomes. 2019;12(6):e005375.
11. Budoff MJ, Lakshmanan S, Toth PP, Hecht HS, Shaw LJ, Maron DJ, et al. Cardiac CT angiography in current practice: An American society for preventive cardiology clinical practice statement☆. American journal of preventive cardiology. 2022;9:100318.
12. Han D, Liu J, Sun Z, Cui Y, He Y, Yang Z. Deep learning analysis in coronary computed tomographic angiography imaging for the assessment of patients with coronary artery stenosis. Computer Methods and Programs in Biomedicine. 2020;196:105651.
13. Mitchell A, De Maria GL, Banning A. Cardiac catheterization and coronary intervention: Oxford University Press, USA; 2020.
14. Aziz MU, Singh S. Computed tomography of coronary artery atherosclerosis: A review. Journal of Medical Imaging and Radiation Sciences. 2021;52(3):S19-S39.
15. Lee S, Kim I-C, Kim YD, Nam HS, Kim Sy, Choi Sm, et al. The role of cardiac CT throughout the full cardiac cycle in diagnosing patent foramen ovale in patients with acute stroke. European Radiology. 2021;31:8983-90.
16. Griffin WF, Choi AD, Riess JS, Marques H, Chang H-J, Choi JH, et al. AI evaluation of stenosis on coronary CTA, comparison with quantitative coronary angiography and fractional flow reserve: a CREDENCE trial substudy. Cardiovascular Imaging. 2023;16(2):193-205.
17. Abbas A, Raza A, Ullah M, Hendi AA, Akbar F, Khan SU, et al. A comprehensive review: epidemiological strategies, catheterization and biomarkers used as a bioweapon in diagnosis and management of cardio vascular diseases. Current Problems in Cardiology. 2023;48(7):101661.
18. Kwan AC, Gransar H, Tzolos E, Chen B, Otaki Y, Klein E, et al. The accuracy of coronary CT angiography in patients with coronary calcium score above 1000 Agatston units: comparison with quantitative coronary angiography. Journal of cardiovascular computed tomography. 2021;15(5):412-8.
19. Xu PP, Li JH, Zhou F, Jiang MD, Zhou CS, Lu MJ, et al. The influence of image quality on diagnostic performance of a machine learning–based fractional flow reserve derived from coronary CT angiography. European Radiology. 2020;30:2525-34.
20. Pack JD, Xu M, Wang G, Baskaran L, Min J, De Man B. Cardiac CT blooming artifacts: clinical significance, root causes and potential solutions. Visual computing for industry, biomedicine, and art. 2022;5(1):29.
21. Castellano IA, Nicol ED, Bull RK, Roobottom CA, Williams MC, Harden SP. A prospective national survey of coronary CT angiography radiation doses in the United Kingdom. Journal of Cardiovascular Computed Tomography. 2017;11(4):268-73.

[Citation: Kalsoom, F., Tariq, S., Zafar, U., Mushtaq, K. (2024). The usefulness of coronary cta in identifying cases of coronary artery disease. *Biol. Clin. Sci. Res. J.*, **2024**: *790*. doi: https://doi.org/10.54112/bcsrj.v2024i1.790]