F-25 | Comparative Analysis of Machine Learning Algorithms for Predicting Coronary Artery Disease Across Diverse Populations

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Background: Coronary artery disease (CAD) remains a leading cause of morbidity and mortality worldwide. While machine learning (ML) algorithms have demonstrated promising accuracy in predicting CAD, limited research has been conducted to evaluate and compare their performance across diverse populations. This review aims to perform a comparative analysis of various ML algorithms in predicting CAD across diverse populations, identifying their strengths, limitations, and adaptability to specific populations.

Methods: The PubMed, Google Scholar, Directory of Open Access Journals, Web of Science databases were systematically searched in compliance with the PRISMA guidelines. Boolean search terms included "(Artificial Intelligence)," "(Machine Learning)," "(Coronary artery disease)". The results were tabulated and analyzed.

Results: Studies from multiple countries highlight global interest in AI for CAD. Of these, 38.9% used retrospective data and 44.4% used prospective data, with a mean age of 62.8 years and 66.7% male population. Various AI techniques were employed, with AI-QCT (Artificial Intelligence Quantitative CT) most commonly used. Accuracy ranged from 83% to 99.7%, depending on the task and stenosis threshold. Sensitivity for detecting stenosis (≥50% and ≥70%) was high, often exceeding 70%. AUC-ROC >0.85 was reported in most of the studies.

Conclusions: AI models demonstrated high diagnostic performance in detecting coronary stenosis, often surpassing human readers and standard methods, enhancing accuracy and efficiency in CAD management.

Author (Year)	Country	Study Type	Male Gender (%)	Mean Age (years)	AI Model	Key Metrics	Conclusion
Dundas (2023)	Canada	Retrospective	60.8	59.7	AI-based coronary stenosis quantification	Per-patient accuracy: 83%, AUC-ROC: 0.88-0.93	High diagnostic performance for stenosis detection
Nabeta (2023)	Finland	Prospective	46	63	AI-based ischemia algorithm	Accuracy: 83%, AUC: 0.853	Improved diagnostic accuracy for myocardial ischemia
Earls (2021)	USA	Prospective	N/A	N/A	AI-based coronary stenosis algorithm	Accuracy: 84-86%, Sensitivity: 94%	Rapid and accurate identification of stenosis
Han (2023)	China	Cross-sectional	70.1	62	Commercial CCTA-AI platform	AUC: 0.78-0.85	Better performance than moderate-experience radiologists
Choi (2021)	USA, Portugal	Multi-center observational	63	60	Deep convolutional neural networks	Accuracy: 99.7%, Sensitivity: 90.9%	High agreement with expert readers
Griffin (2023)	Multi-national	Prospective	71	64	AI-QCT	Accuracy: 84-86%, AUC: 0.88-0.92	Rapid and accurate stenosis identification
Lipkin (2022)	South Korea	Retrospective	71	64.4	AI-QCT	Sensitivity: 95%, NPV: 92-98%	Higher diagnostic performance than MPI
Al'Aref (2020)	USA	Nested Case-Control	66.1	62.6	XGBoost	Specificity: 89.3%	Effective for predicting culprit lesions
Yabushita (2021)	China, Japan	Retrospective	N/A	N/A	3D CNN	Accuracy: 60%, Sensitivity: 61%	Modest predictive value for stenosis detection
Meng (2023)	China	Retrospective	Dataset ISQ- 60.6, Dataset ESQ- 64.5	N/A	InferRead CTA	Sensitivity: 86.8-94.2%	Exceptional proficiency in stenosis quantification
Omori (2023)	Japan	Prospective & Retrospective	74.5	68	Quantitative CT with CNN	Accuracy: 84-86%, Sensitivity: 94%	Excellent performance for plaque detection
Baskaran (2020)	Multi-national	Randomized controlled trial	55.1	60.6	XGBoost	Accuracy: 90.4%, AUC: 0.779	Outperformed traditional clinical scoring
Upton (2022)	UK	Prospective	50	64.5	Supervised ML model	Sensitivity: 84.4%, Specificity: 92.7%	Improved accuracy and reader confidence
Gao (2024)	China	Retrospective	N/A	N/A	Multiple ML models	XGBoost AUC: 0.800	Best prediction with the XGBoost model
Leasure (2021)	USA	Retrospective	66.9	66.2	ECGio AI algorithm	Sensitivity: 93.2%, Specificity: 96.4%	Effective CAD detection from ECG data
Guo (2023)	China	Prospective	62.9	64.1	Multiple ML classifiers	Sensitivity: 95.2%, AUC: 0.852	Improved CAD detection with echocardiography
Zhang (2024)	China	Prospective	62.6	62.7	FAAI-based CCTA	Accuracy: 94.7%, Sensitivity: 96.3%	Non-inferior diagnosis with improved workflow
Nurmohamed (2024)	Netherlands	Prospective	55.4	58.6	AI-QCT	10-year AUC: 0.82	Superior prognostic value over traditional methods

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During the preparation of this work, the author(s) used generative AI or AI-assisted technology. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

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F-26 | Left-Ventricle Global Longitudinal Strain and Coronary Microvascular Dysfunction in Patients With Preserved Ejection Fraction- A Single Center Study

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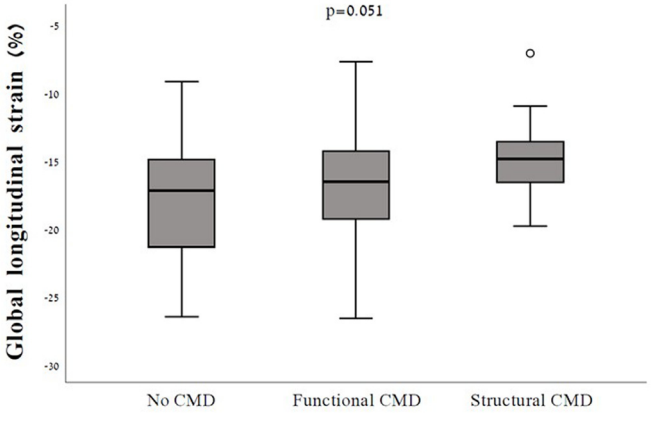
Background: Left ventricle global longitudinal strain (LVGLS) can detect early myocardial injury. Reduced LVGLS is associated with worse clinical outcomes in several cardiovascular conditions. Whether LVGLS is reduced in patients with coronary microvascular dysfunction is unknown.

Methods: We included patients with non-obstructive CAD undergoing invasive assessment of coronary microvascular function. LVGLS measurement was performed using a semi-automated tracking software. Associations between LVGLS, echocardiographic parameters and coronary microvascular function, were assessed using univariate and multivariate regression models.

Results: Overall, 75 patients were included in the analysis (57% female; median age 65 (interquartile range [IQR]: 56, 73) of which 40 (53%) had evidence of coronary microvascular dysfunction. Median EF was 60% in both groups. Patients with CMD had numerically lower LVGLS compared to patients without CMD (-16% [IQR: -18, -14] vs. -17.3% [IQR: -22, -15; p=0.06). Patients with structural CMD (-14.9%; -16.7, -13.7) vs. functional CMD (-16.6%; -19.4, -14.4), and no CMD (-17.6%; IQR: -21.6, -15.2) had lower LVGLS (P for trend=0.051. In a multivariate analysis, reduced LVGLS (<17.5%) was found to be independently associated with CMD (adjusted odds ratio: 3.6; 95% confidence interval: 1.18-11; p=0.025).

Conclusions: Patients with CMD and preserved ejection function have lower LVGLS compared to patients without CMD, with a trend towards worse LVGLS among patients with structural versus functional and no CMD. Reduced LVGLS might emerge as an early non-invasive clinical marker for coronary microvascular dysfunction.



Disclosures: L. Zornitzki, Y. Barlev, A. Shetrit, O. Freund, M. Zuniga, R. Amar Shamir, J. Ben Shoshan, Y. Arbel, S. Banai, M. Konigstein, *Nothing to disclose.*

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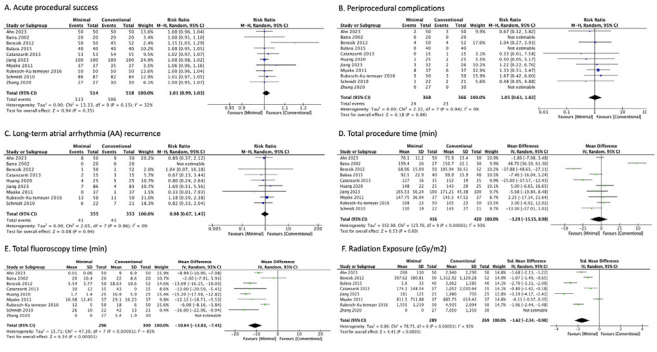
Intravascular Imaging (IVUS/OCT/NIR/Other) and Physiology (FFR/iFR/IMR/other)

F-27 | Safety and Efficacy of Minimal Fluoroscopic Imaging Technique vs Conventional Imaging Technique for Patients With Atrial Arrhythmias Undergoing Catheter Ablation: A Meta-Analysis of Randomised Controlled Trials

Nandan Patel, MBBS [1], Hritvik Jain, MBBS [2], Hassaan Abid, MD [3], Arya Kulkarni [4], Rahul Patel, MD [5], Nishad Barve, MD [6], Raveena Kelkar, MD [7], Hina Farrukh, MD [8], Shrey Gole, MD [9], Amit Hooda, MD, FSCAI [10], [1] *All India Institute of Medical Sciences, Jodhpur, Jodhpur, NJ, India;* [2] *All India Institute of Medical Sciences, Jodhpur, Jodhpur, Rajasthan, India;* [3] *IU Health Ball Memorial Hospital, Muncie, IN;* [4] *Gujarat Medical Education and Research Society (GMERS), Vadnagar, Gujarat, India;* [5] *UNC Health Blue Ridge, Morganton, NC;* [6] *Tufts Medicine Lowell General Hospital, Lowell, MA;* [7] *Wentworth-Douglass Hospital, Mass General Brigham, Dover, NH;* [8] *University of Florida Health - Central Florida, The Villages, FL;* [9] *Stanford University Medical Center, Stanford, CA;* [10] *Icahn School of Medicine at Mount Sinai, New York, NY*

Background: The implementation of a minimal or zero-fluoroscopy approach for catheter ablation in atrial fibrillation (AF) treatment offers a safer alternative to conventional fluoroscopy.
Methods: MEDLINE, Embase, Cochrane Library, and Web of Science databases were systematically searched to identify relevant RCTs. Odds ratio (OR), risk ratios (RRs), and standardized mean differences (SMD) with 95% CIs were pooled using the Mantel-Haenszel random effects model.
Results: A total of 14 studies with 1927 patients were included. The pooled analysis showed no significant difference and non-inferiority in acute procedural success between minimal fluoroscopic and conventional approaches [RR: 1.01, 95% CI: 0.99–1.03, $p = 0.35$]. Similarly, no significant difference or non-inferiority was found in periprocedural complications [RR: 1.05, 95% CI: 0.61–1.82, $p = 0.86$], long-term atrial arrhythmia recurrence [RR: 0.98, 95% CI: 0.67–1.45, $p = 0.94$], or total procedure time [MD: -3.29 minutes, 95% CI: -15.85 to 8.98]. However, fluoroscopy time was markedly reduced [MD: -10.64 minutes, 95% CI: -13.83 to -7.45, $p < 0.0001$], and radiation exposure was significantly lower in the minimal approach group [SMD: -1.62, 95% CI: -2.34 to -0.90, $p < 0.0001$].
Conclusions: This meta-analysis shows the minimal fluoroscopic approach is non-inferior to the conventional approach in terms of acute procedural success, periprocedural complications, long-term atrial arrhythmia recurrence, and total procedure time. However, it significantly reduces fluoroscopy time and radiation exposure, highlighting its potential as a safer alternative while maintaining procedural efficacy.



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F-28 | Optical Coherence Tomography, Intravascular Ultrasound, and Angiography as Guidance for Drug-Eluting Stent Implantation in Complex Coronary Artery Lesions: A Lesion-Level Network Meta-Analysis of Randomized Controlled Trials

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Background: Intravascular imaging–guided PCI reduces cardiovascular outcomes when compared with angiography-guided PCI. However, there is a paucity of data comparing these approaches in patients with complex coronary artery lesions and their respective subgroups.
Methods: Databases were searched for randomized controlled trials (RCTs) reporting outcomes following intravascular imaging–guided or angiography-guided PCI using DES. We separately compared OCT, IVUS, and angiography as guidance for PCI. Using a frequentist random-effects model network meta-analysis, we calculated risk ratios (RR) for each strategy. The primary endpoint was MACE, defined as a composite of cardiac death, myocardial infarction, or target-vessel revascularization.
Results: Sixteen RCTs including 12,420 patients with complex coronary lesions undergoing PCI with DES, were incorporated into the analysis. In the network, both OCT (RR 0.68; 95% CI 0.57-0.81) and IVUS (RR 0.68; 95% CI 0.59-0.78) demonstrated superiority over angiography-guided PCI in preventing MACE in complex lesions. No significant difference was observed between OCT and IVUS (RR 1.00; 95% CI 0.82-1.21). These results were consistent in the subgroups of patients with CTO, left main coronary artery disease, bifurcation lesions, multivessel coronary artery disease, and calcified lesions (Figure 1).
Conclusions: In patients with complex coronary lesions undergoing PCI with DES, both OCT-guided PCI and IVUS-guided PCI are effective in reducing MACE rates when compared with angiography-guided PCI. These findings were consistent across various types of complex coronary lesions.