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Characteristic of Clinical Likelihood Chronic Coronary Syndrome patients with Significant Coronary Lesion in RSUP dr. Mohammad Hoesin Palembang

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ABSTRACT

Chronic coronary syndrome (CCS) is a pathological process characterized by atherosclerotic plaque accumulation in the epicardial arteries, whether obstructive or non-obstructive. Significant Coronary artery disease (CAD) is defined by invasive coronary angiography as >50% stenosis of the left main stem, >70% stenosis in a major coronary vessel, or 30% to 70% stenosis with fractional flow reserve ≤0.8. This study aimed to identify the characteristics of clinical likelihood CCS patients with site of significant coronary lesion based on pre-test probability (PTP) from demographic characteristics; risk factors; laboratory and echocardiography findings. This is a retrospective cohort study. We reviewed 60 medical records of clinical likelihood chronic coronary syndrome patients with positive inducible ischemia area from dobutamine stress echocardiography and significant CAD lesion from coronary angiography. The incidence of significant CAD in this population was 56.1%. There was a significant relationship between age > 65 years with the incidence of significant LAD lesion (23.3%, p = 0.019); significant LCx lesion (20%, p = 0.043). There was a significant relationship between PTP score ≥ 16% with significant LAD lesion (55.0%, p = 0.001); significant LCx lesion (45.0%, p = 0.031); and significant RCA lesion (40.0%, p = 0.050). Patients with age > 65 years have a higher incidence of significant LAD and LCx lesions. Patients with pre-test probability score ≥ 16% have a higher incidence of significant lesions across coronary branches, predominantly in the LAD.

Keywords: Chronic Coronary Syndrome, Significant Coronary Artery Disease, Dobutamine Stress Echocardiography

INTRODUCTION

Coronary artery disease (CAD) is a pathological process characterized by atherosclerotic plaque accumulation in the epicardial arteries, whether obstructive or non-obstructive. The dynamic nature of the CAD process results in various clinical presentations, which can be

conveniently categorized as either acute coronary syndromes (ACS) or chronic coronary syndromes (CCS) (Boden et al., 2023; Buse et al., 2021; Panuccio et al., 2023; Vink et al., 2023). Significant Coronary artery disease (CAD) is defined by invasive coronary angiography as >50% stenosis of the left main stem, >70% stenosis in a major coronary vessel, or 30% to 70% stenosis with fractional flow reserve ≤0.8 .

Global longitudinal strain (GLS) in the early stage of acute myocardial infarction in patients with preserved left ventricular ejection fraction (LVEF) (Abou et al., 2021; Anastasiou et al., 2023; Driss et al., 2020; Haji et al., 2022; Thellier et al., 2020). Enlarged LVEDD was an independent predictor of all-cause mortality in patients with CAD. high left ventricular (LV) mass/end-diastolic volume ratio (LVM/EDV) is related to LV dysfunction and myocardial fibrosis (Huang et al., 2024; Joseph et al., 2019; Turkbey et al., 2022).

The 2019 ESC guidelines updated the method for estimating the pre-test probability (PTP) of obstructive coronary artery disease (CAD). The concept of pretest probability (PTP) based on variables such as sex, age and angina characteristics. This pre-test probability can be further modified by applying other known clinical risk markers such as smoking, hypertension diabetes, dyslipidemia, family history of CVD, resting ECG changes (Q wave or ST-segment/T wave changes), LV dysfunction suggestive of CAD, abnormal excersice ECG and coronary Calcium by CT. This can be correspondingly diminished or augmented to give a clinical likelihood ratio for obstructive CAD (Boivin-Proulx et al., 2023; Dai et al., 2024; Rinaldi et al., 2024; Sands & Edwards, 2023).

Stress echocardiography has reached its established rank in the diagnosis and prognosis of coronary artery disease (Kadoglou et al., 2022; Pargaonkar et al., 2020; Pezel et al., 2021). Dobutamine stress echocardiography is the best test for viability, and dipyridamole the safest and simplest pharmacological stress and the most suitable for combined wall motion coronary flow reserve assessment.This study aimed to identify the characteristics of significant coronary lesion patients with low clinical likelihood CCS patients with site of significant coronary lesion based on pre-test probability (PTP); demographic characteristics; risk factors; laboratory and echocardiography findings.

RESEARCH METHODS

We designed this study as a retrospective cohort study. Therefore, we reviewed medical records of 60 patients with CCS who had been evaluated has a positive coronary lesion based on dobutamine stress echocardiography (DSE) and significant coronary lesion based on coronary angiography at Mohammad Hoesin Hospital Palembang between January 2022 and March 2023. Data then analyzed using SPSS Statistics 23. Data were analyzed using bivariate analysis. Variables with p value <0.25 were taken and a second bivariate analysis was carried out to compare the variables with the site of lesion on significant CAD (LM, LAD, LCx, RCA).

Variables with p value <0.05 were analyzed using multivariate analysis. Variables with p value <0.05 considered to have a significant relationship.

The diagnosis of CCS was establish on the basis following criteria: (i) patients with suspected CAD and 'stable' anginal symptoms, and/or dyspnea, (ii) patients with new onset of heart failure (HF) or left ventricular (LV) dysfunction and suspected CAD, (iii) asymptomatic and symptomatic patients with stabilized symptoms <1 year after an ACS, or patients with recent revascularization, (iv) asymptomatic and symptomatic patients >1 year after initial diagnosis or revascularization, (v) patients with angina and suspected vasospastic or microvascular disease, and (vi) asymptomatic subjects in whom CAD is detected at screening (Pacheco et al., 2022).

Patients with CCS criteria and had positive DSE examination and significant coronary lesions were included in the study. Patients who have CCS criteria but negative DSE results are exclude in the exclusion criteria. From 100 patients, we exclude 40 patients who had negative DSE. In total 60 patients who had positive DSE and significant coronary lesion were enrolled in this study (figure 1).

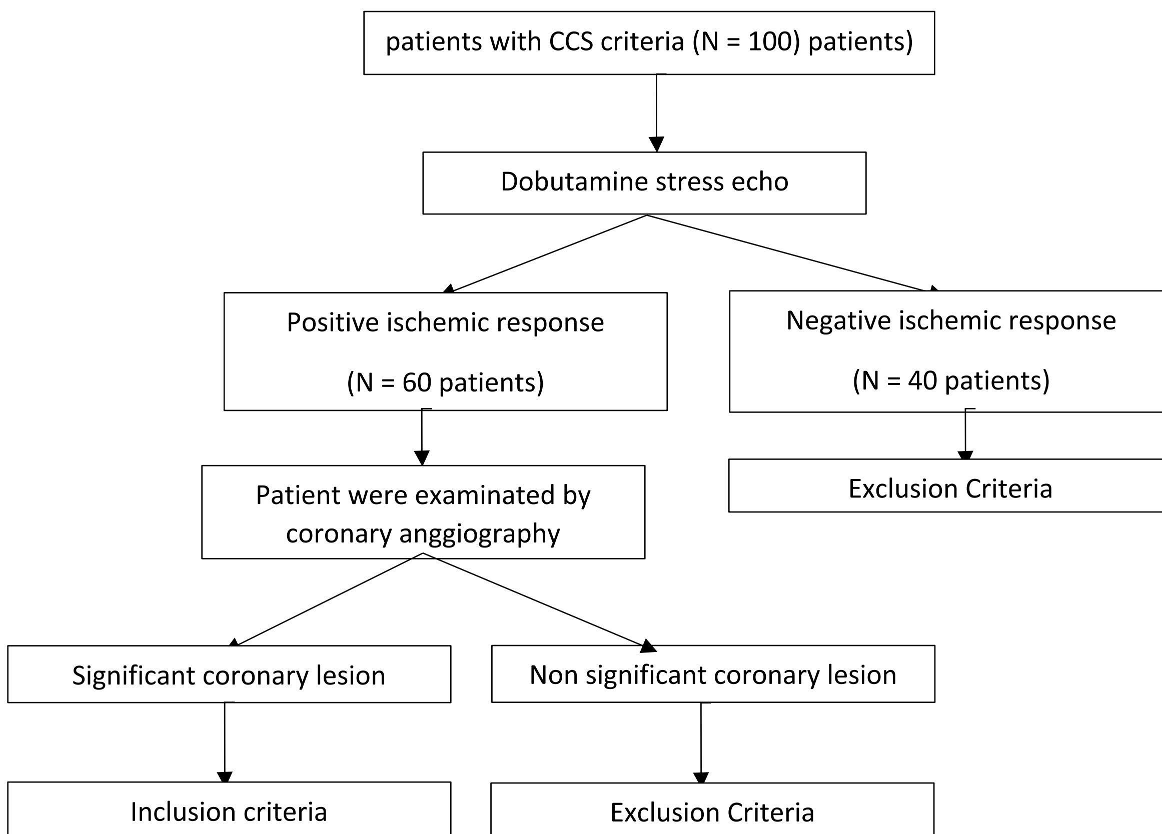

Figure 1. Inclusion and Exclusion Criteria

This study were approved by local ethics committee based on research protocol. The requirement of informed consent was waived by the committee.

RESULTS AND DISCUSSION

Bivariate Analysis of Significant and Non-Significant CAD

Bivariate analysis of low clinical likelihood significant and non-significant CAD. This research was conducted retrospectively significant coronary syndrome patients with positive DSE examinations and coronary angiography examination from January 2022 to March 2023.

Table 1. Basic characteristics of the samples

Variabel	Samples N = 60	CAD significant N = 46 (56.1%)	CAD nonsignificant N = 14 (17.1%)	Nilai *p*
Demographic characteristics				
Age ≥ 65 tahun	16 (26.7%)	15 (25.0%)	1 (1.7%)	0.055
Gender				
• Male [n (%)]	42 (70.0%)	36 (60.0%)	6 (10.0%)	0.016
• Female [n (%)]	18 (30.0%)	10 (16.7%)	8 (13.3%)	
Smoking [n (%)]	42 (70.0%)	36 (60.0%)	6 (3.3%)	0.016
Diabetes Melitus History [n (%)]	17 (28.3%)	15 (25.0%)	2 (81.8%)	0.161
Hypertension History [n (%)]	48 (80.0%)	36 (60.0%)	12 (20.0%)	0.426
Clinical Parameters				
Blood Pressure ≥ 140/90 (TD)	16 (26.7%)	13 (21.7%)	3 (5.0%)	0.448
End Diastolic Volume (EDV) > 235 [n (%)]	1 (1.7%)	0 (0.0%)	1 (1.7%)	0.233
End Diastolic Diameter >5.6 cm (EDD/LVIDd) [n (%)]	9 (15.0%)	5 (10.0%)	3 (5.0%)	0.345
Global Longitudinal Strain < -15.6% (GLS) [n (%)]	48 (80.0%)	39 (65.0%)	9 (15.0%)	0.100
Laboratory Findings				
LDL ≥ 100 [n (%)]	39 (65.0%)	29 (48.3%)	10 (16.7%)	0.406
TG ≥ 150 [n (%)]	29 (48.3%))	24 (40.0%)	5 (8.3%)	0.220
GDS ≥ 200 [n (%)]	6 (10.0%)	6 (!0.0%)	0 (0.05)	0.187
HbA1C ≥ 5.6 [n (%)]	44 (73.3%)	35 (58.3%)	9 (15.0%)	0.292
Pre-Test Probability ≥ 16%	43 (71.7%)	40 (66.7%)	3 (5.0%)	0.000

The proportion of significant CAD in this population was 56.1% and non significant CAD was 17.1%. From these data it is known that patients with aged > 65 years have a higher incidence of significant CAD than non-significant CAD (25.0% vs 1.7%, p = 0.055). Patients with male gender had a higher proportion of significant CAD than non-significant CAD (60.0% vs 10.0%, p = 0.016). There was a significant difference between gender in significant and non-significant CAD (60.0% vs 16.7%, p = 0.016). Patients with history of smoking and CAD significant and CAD non significant (60.0% vs 3.3%, p = 0.016). Proportion of patients with history of DM type II with significant CAD and non significant CAD (25.0% vs 81.8%, p = 0.161).

The proportion of significant CAD and non significant CAD in patients with history of hypertension (60.0% vs 20.0%, p=0.426).

Patients with significant CAD higher than non significant CAD with BP > 140/80 mmHg (21.7% vs 5.0%, p = 0.448). From Dobutamine Stress Echocardiography (DSE) examination, patients with significant CAD higher than non significant CAD with EDV > 235 ml (0.0% vs 1.7%, p = 0.233). Patients with significant CAD higher than non significant CAD with EDD values > 5.6 cm (10.0% vs 5.0%, p = 0.345). Proportion of significant CAD higher than non significant CAD in patients with GLS values below -15.6% (65.0% vs 15.0%, p = 0.100).

From laboratory examinations, patients with significant CAD lower than non significant CAD with LDL values > 100 mg/dL (48.3% vs 16.7%, p = 0.406). Patients with significant CAD higher than non significant CAD with triglyceride values > 150 mg/dL (40.0% vs 8.3%, p = 0.220). Patients with significant CAD higher than non significant CAD with GDS values > 200 mg/dL (10.0% vs 0.05%, p = 0.187). Patients with significant CAD higher than non significant CAD in patients with HbA1C values > 5.6 (58.3% vs 15.0%, p = 0.292).

Based on demographic characteristics, clinical symptoms of the patient, the results of echocardiography and laboratory examinations, we summarized the patient data and calculated the PTP value based on the 2019 ESC guideline.4 We found that the proportion of significant CAD higher than non significant CAD events in patients with a PTP value > 16% (66.2% vs 5.0%, p = 0.000).

Bivariate Analysis Characteristics Patients Based on Site of Lesion in significant CAD

The variables included in the bivariate analysis are 10 previously determined determinants. The statistical test used for bivariate analysis is the Chi-Square Test. This test is used because the determinants are categorical. So the first step is to change the numerical variable to categorical. Variables that are converted into categorical include:

Table 2. Bivariate Analysis Characteristics Patients Based on LM Disease

Variable	CAD Significant LM		P	OR	Confidental Interval 95 %	
	N	%			Minimum	Maximum
Age > 65 years	4	6.7	0.182	2.600	0.601	11.256
Gender Male	6	10.0	0.547	0.833	0.184	3.777
Smoking Yes	6	10.0	0.547	0.833	0.184	3.777
Diabetes Melitus History	3	5.0	0.499	1.321	0.290	6.019

Yes						
EDV> 235ml	0	0	0.850	0.847	0.761	0.944
Yes						
GLS<-15.6%	7	11.7	0.580	0.854	0.153	4.752
Yes						
TG > 150	5	8.3	0.640	1.150	0.338	5.848
Yes						
GDS>200	8	13.3	0.640	1.150	0.118	11.182
Yes						
PTP>16%	8	13.3%	0.205	3.657	0.421	31.755
Yes						

From the data above, it was found that patients with age > 65 years and the incidence of LM disease (6.7%, p = 0.182). Patients with male gender and LM disease (10.0%, p = 0.547). Patients with a history of previous smoking and LM disease (10.0%, p = 0.547). Patients with a history of DM and LM disease (5.0%, p = 0.499). Patients with EDV values > 235 ml and LM disease (0%, p = 0.850). Patients with GLS < -15.6% and LM disease (11.7%, p = 0.580). Patients with TG > 150 mg/dL and LM disease (8.3%, p = 0.456). Patients with GDS > 200 mg/dL and LM disease (13.3%, p = 0.640). Patients with PTP values > 16% and LM disease (13.3%, p = 0.205).

Table 3. Bivariate Analysis Characteristics Patients Based on Significant LAD Lesion

Variable	CAD Significant LM		P	OR	Confidental Interval 95 %	
	N	%			Minimum	Maximum
Age > 65 years	14	23.3	0.017	5.833	1.182	28.778
Gender Male	28	46.7	0.297	1.600	0.517	4.951
Smoking Yes	28	46.7	0.297	1.600	0.517	4.951
Diabetes Melitus History Yes	11	18.3	0.567	1.086	0.337	3.505
EDV> 235ml Yes	0	0	0.367	0.356	0.253	0.502
GLS<-15.6% Yes	33	55.0	0.081	2.080	0.840	11.300
TG > 150	21	35.0	0.126	2.162	0.735	6.357

Yes						
GDS>200	4	6.7	0.616	1.176	0.197	7.011
Yes						
PTP>16%	33	55.0	0.001	7.920	2.245	27.936
Yes						

Patients with age > 65 years and the incidence of significant LAD lesion (23.3%, p = 0.017). Patients with male gender and significant LAD lesion (46.7%, p = 0.297). Patients with a history of smoking and significant LAD lesion (46.7%, p = 0.297). Patients with a history of DM and significant LAD lesion (18.3%, p = 0.567). Patients with EDV values > 235 ml and significant LAD lesions (0%, p = 0.367). Patients with GLS < -15.6% and significant LAD lesions (55.0%, p = 0.081). Patients with TG > 150 mg/dL and significant LAD lesion (35.0%, p = 0.126). Patients with GDS > 200 mg/dL and significant LAD lesion (6.7%, p = 0.616). Patients with PTP values > 16% and significant LAD lesion (55.0%, p = 0.001).

Table 4. Bivariate Analysis Characteristics Patients Based on Significant LCx Lesion

Variable	CAD significant LCx		P	OR	Confidential Interval 95%	
	N	%			Minimum	Maximum
Age						
≥ 65 years	12	20.0	0.040	3.600	1.003	12.919
Gender						
Male	24	40.0	0.267	1.677	0.548	5.070
Smoking						
Yes	24	40.0	0.267	1.667	0.548	5.070
Diabetes Melitus History						
Yes	11	18.3	0.206	1.1921	0.602	6.130
EDV > 235 ml						
Yes	0	0	0.467	0.458	0.347	0.604
GLS < -15.6%						
Yes	26	43.3	0.524	1.182	0.333	4.192
TG ≥ 150						
Yes	18	30.0	0.146	1.987	0.709	5.571

GDS ≥ 200						
Yes	5	8.3	0.131	5.000	0.547	45.684
PTP ≥ 16%						
Yes	27	45.0	0.020	4.050	1.204	13.619

Patients aged > 65 years and the incidence of significant LCx lesion (20.0%, p = 0.040). Patients with male gender and significant LCx lesion (40.0%, p = 0.267). Patients with a previous history of smoking and significant LCx lesion (40.0%, p = 0. 267). Patients with a history of DM and significant LCx lesion (18.3%, p = 0.206). Patients with EDV values > 235 ml and significant LCx lesions (0%, p = 0.467). Patients with GLS < -15.6% and significant LCx lesions (43.3%, p = 0.524). Patients with TG > 150 mg/dL and significant LCx lesions (30.0%, p = 0.146). Patients with GDS > 200 mg/dL and significant LCx lesions (8.3%, p = 0.131). Patients with PTP values > 16% and significant LCx lesions (45.0%, p = 0.020).

Table 5. Bivariate Analysis Characteristics Patients Based on Significant RCA Lesion

Variable	CAD significant		P	OR	Confidential Interval	
	RCA				95%	
	N	%			Minimum	Maximum
Age						
≥ 65 years	9	15.0	0.272	1.692	0.534	5.364
Gender						
Male	20	33.3	0.523	1.136	0.375	3.446
Smoking						
Yes	20	33.3	0.523	1.136	0.375	3.446
Diabetes Melitus History						
Yes	11	18.3	0.070	2.804	0.872	9.012
EDV > 235 ml						
Yes	0	0	0.533	0.525	0.412	0.670
GLS < -15.6%						
Yes	22	36.7	0.524	0.846	0.239	3.001
TG ≥ 150						

Yes	17	28.3	0.062	2.576	0.908	7.308
GDS ≥ 200						
Yes	5	8.3	0.070	6.739	0.737	61.663
PTP ≥ 16%						
Yes	24	40.0	0.023	4.105	1.151	14.648

Patients age > 65 years and the incidence of significant RCA lesion (15.0%, p = 0.272). Patients with male gender and significant RCA lesions (33.3%, p = 0.523). Patients with a previous history of smoking and significant RCA lesion (33.3%, p = 0.523). Patients with a history of DM and significant RCA lesion (18.3%, p = 0.070). Patients with EDV values > 235 ml and significant RCA lesions (0%, p = 0.533). Patients with GLS < -15.6% and significant RCA lesions (36.7%, p = 524). Patients with TG > 150 mg/dL and significant RCA lesions (28.3%, p = 0.062). Patients with GDS > 200 mg/dL and significant RCA lesions (8.3%, p = 0.070). Patients with PTP values > 16% and significant RCA lesions (40.0%, p = 0.023).

Multivariate Analysis

Variables that will be included in the multivariate analysis are variables that in the bivariate analysis have a p value smaller than 0.05. Based on the bivariate analysis that has been carried out previously, the variables that can be entered into the multivariate analysis are: patients aged > 65 years with significant LAD lesion (p = 0.017), significant LCx lesion (p = 0.040). Patients with PTP values > 16% had significant LAD lesion (p = 0.001), significant LCx lesion (p = 0.020), and significant RCA lesion (p = 0.023).

The multivariate analysis used is logistic regression with the backward selection method where variables that have a p value of more than 0.05 will be excluded and repeated multivariate analysis will be carried out until the final result is a final model with significant variables with a p value ≤ 0.05. Logistic regression was chosen because the dependent variable is a variable. categorical.

Tabel 6. Multivariate Analysis

Variable	P value	Confidance Interval 95%	
		Minimum	Maximum
Age ≥ 65 years			
Significant LAD	0.019	0.641	1.109
Significant LCx	0.043	0.307	0.602

PTP ≥ 16%			
Significant LAD	0.001	0.201	0.776
Significant LCx	0.031	0.033	0.666
Significant RCA	0.050	9.889	0.635

The results of the multivariate analysis, it was found that there was a significant relationship between age > 65 years and significant LAD lesions (p = 0.019). Significant relationship between age > 65 years and significant LCx lesions (p = 0.043). Significant relationship between PTP > 16% and significant LAD lesions (p = 0.001). Significant relationship between PTP > 16% and significant LCx lesions (p = 0.031). Significant relationship between PTP > 16% and significant RCA lesions (40.0%, p = 0.050).

From the results of the first bivariate analysis, it was found that the highest characteristic with a p value <0.25 in patients with significant CAD was age > 65 years; male gender; history of smoking and history of diabetes mellitus; EDV > 235 and GLS < - 15.6 which indicates the patient has LV dysfunction; blood pressure > 140/90; LDL > 100 mg/dL and TG > 150 mg/dL; GDS > 200 mg/dL and HbA1C > 5.6.

From demographic characteristics, clinical parameters using echocardiography and sphymomanometer as well as laboratory examination results, we grouped patients based on PTP values < 16% and > 16% using the 2019 ESC guidelines. From the results of bivariate analysis, PTP values > 16% and significant CAD incidence rates were obtained = 0.000. Then we correlated age > 65 years and PTP > 16% with the site of lesion on significant CAD to see whether there was a relationship between age 65 years and PTP > 16% and the incidence of LM disease or significant lesions found on the LAD, LCx or RCA.

The results from the data analysis, it was found that there is a significant relationship between age > 65 years and significant LAD lesions (p = 0.019). There is a significant relationship between age > 65 years and significant LCx lesions (p = 0.043). There is a significant relationship between PTP > 16% and significant LAD lesions (p = 0.001). There is a significant relationship between PTP > 16% and significant LCx lesions (p = 0.031). There is a significant relationship between PTP > 16% and significant RCA lesions (40.0%, p = 0.050). The limitation in this research is that the lack of research samples makes the data difficult to analyze using multivariate analysis and many biases in the research.

CONCLUSION

In conclusion, the bivariate analysis of significant and non-significant CAD revealed important associations between demographic characteristics, clinical parameters, and laboratory findings. Notably, patients aged over 65 years showed a higher incidence of

significant CAD, especially in the left anterior descending (LAD) and left circumflex (LCx) arteries. Male gender, a history of smoking, and higher pre-test probability (PTP) values (>16%) were also significantly associated with significant CAD, with correlations observed in specific coronary arteries. Additionally, certain clinical parameters such as elevated blood pressure, abnormal echocardiography results, and specific laboratory findings were associated with significant CAD. The multivariate analysis further confirmed the significant relationships between age > 65 years, PTP > 16%, and the presence of significant lesions in the LAD, LCx, and right coronary artery (RCA). However, it is essential to acknowledge the limitations of this study, including a small sample size and potential biases, which may impact the generalizability of the findings.

BIBLIOGRAPHY

Abou, R., Goedemans, L., Montero-Cabezas, J. M., Prihadi, E. A., El Mahdiui, M., Schalij, M. J., Marsan, N. A., Bax, J. J., & Delgado, V. (2021). Prognostic value of multilayer left ventricular global longitudinal strain in patients with ST-segment elevation myocardial infarction with mildly reduced left ventricular ejection fractions. *The American Journal of Cardiology*, *152*, 11–18.

Anastasiou, V., Daios, S., Moysidis, D. V, Zegkos, T., Liatsos, A. C., Stalikas, N., Didagelos, M., Tsalikakis, D., Sarafidis, P., & Delgado, V. (2023). Right ventricular global longitudinal strain and short-term prognosis in patients with first acute myocardial infarction. *The American Journal of Cardiology*, *205*, 302–310.

Boden, W. E., Marzilli, M., Crea, F., Mancini, G. B. J., Weintraub, W. S., Taqueti, V. R., Pepine, C. J., Escaned, J., Al-Lamee, R., & Gowdak, L. H. W. (2023). Evolving management paradigm for stable ischemic heart disease patients: JACC Review Topic of the Week. *Journal of the American College of Cardiology*, *81*(5), 505–514.

Boivin-Proulx, L.-A., Potter, B. J., Dorais, M., & Perreault, S. (2023). Evolution of and Evidence-Practice Gaps in Antithrombotic Management of Atrial Fibrillation Patients After Percutaneous Coronary Intervention. *CJC Open*, *5*(1), 15–23.

Buse, G. A. L. L., Puelacher, C., Gualandro, D. M., Kilinc, D., Glarner, N., Hidvegi, R., Bolliger, D., Arslani, K., Lampart, A., & Steiner, L. A. (2021). Adherence to the European Society of Cardiology/European Society of Anaesthesiology recommendations on preoperative cardiac testing and association with positive results and cardiac events: a cohort study. *British Journal of Anaesthesia*, *127*(3), 376–385.

Dai, L., Guo, J., Hui, X., Wang, X., Luo, J., Huang, R., & Xiao, Y. (2024). The potential interaction between chemosensitivity and the development of cardiovascular disease in obstructive sleep apnea. *Sleep Medicine*, *114*, 266–271.

Driss, A. Ben, Lepage, C. B. D., Sfaxi, A., Hakim, M., Elhadad, S., Tabet, J. Y., Salhi, A., Carreira, V. B., Hattab, M., & Meurin, P. (2020). Strain predicts left ventricular functional recovery after acute myocardial infarction with systolic dysfunction. *International Journal of Cardiology*, *307*, 1–7.

Haji, K., Marwick, T. H., Stewart, S., Carrington, M., Chan, Y.-K., Chan, W., Huynh, Q., Neil, C., &

Wong, C. (2022). Incremental value of global longitudinal strain in the long-term prediction of heart failure among patients with coronary artery disease. *Journal of the American Society of Echocardiography*, *35*(2), 187–195.

Huang, Q., Wang, S., He, J., Xu, D., Abdou, S. N., Ibrahim, M. M., Sun, S., Chen, Y., Li, H., & Xu, B. Bin. (2024). Experimental design of paraffin/methylated melamine-formaldehyde microencapsulated composite phase change material and the application in battery thermal management system. *Journal of Materials Science & Technology*, *169*, 124–136.

Joseph, G., Zaremba, T., Johansen, M. B., Ekeloef, S., Heiberg, E., Engblom, H., Jensen, S. E., & Sogaard, P. (2019). Echocardiographic global longitudinal strain is associated with infarct size assessed by cardiac magnetic resonance in acute myocardial infarction. *Echo Research & Practice*, *6*(4), 81–89.

Kadoglou, N. P. E., Papadopoulos, C. H., Papadopoulos, K. G., Karagiannis, S., Karabinos, I., Loizos, S., Theodosis-Georgilas, A., Aggeli, K., Keramida, K., & Klettas, D. (2022). Updated knowledge and practical implementations of stress echocardiography in ischemic and non-ischemic cardiac diseases: An expert consensus of the Working Group of Echocardiography of the Hellenic Society of Cardiology. *Hellenic Journal of Cardiology*, *64*, 30–57.

Pacheco, C., Mullen, K.-A., Coutinho, T., Jaffer, S., Parry, M., Van Spall, H. G. C., Clavel, M.-A., Edwards, J. D., Sedlak, T., & Norris, C. M. (2022). The Canadian Women's Heart Health Alliance Atlas on the epidemiology, diagnosis, and management of cardiovascular disease in women—chapter 5: sex-and gender-unique manifestations of cardiovascular disease. *CJC Open*, *4*(3), 243–262.

Panuccio, G., Carabetta, N., Torella, D., & De Rosa, S. (2023). Clinical impact of coronary revascularization over medical treatment in chronic coronary syndromes: a systematic review and meta-analysis. *Hellenic Journal of Cardiology*.

Pargaonkar, V. S., Rogers, I. S., Su, J., Forsdahl, S. H., Kameda, R., Schreiber, D., Chan, F. P., Becker, H.-C., Fleischmann, D., & Tremmel, J. A. (2020). Accuracy of a novel stress echocardiography pattern for myocardial bridging in patients with angina and no obstructive coronary artery disease–a retrospective and prospective cohort study. *International Journal of Cardiology*, *311*, 107–113.

Pezel, T., Hovasse, T., Kinnel, M., Unterseeh, T., Champagne, S., Toupin, S., Garot, P., Sanguineti, F., & Garot, J. (2021). Prognostic value of stress cardiovascular magnetic resonance in asymptomatic patients with known coronary artery disease. *Journal of Cardiovascular Magnetic Resonance*, *23*(1), 19.

Rinaldi, R., Colucci, M., Torre, I., Ausiello, D., Bonanni, A., Basile, M., Salzillo, C., Sanna, T., Liuzzo, G., & Leone, A. M. (2024). Predicting the response to acetylcholine in ischemia or infarction with non-obstructive coronary arteries: The ABCD score. *Atherosclerosis*, 117503.

Sands, S. A., & Edwards, B. A. (2023). Pro: can physiological risk factors for obstructive sleep apnea be determined by analysis of data obtained from routine polysomnography? *Sleep*, *46*(5), zsac310.

Thellier, N., Altes, A., Appert, L., Binda, C., Leman, B., Marsou, W., Debry, N., Joly, C., Ennezat, P.-V., & Tribouilloy, C. (2020). Prognostic importance of left ventricular global longitudinal strain in patients with severe aortic stenosis and preserved ejection fraction. *Journal of the American Society of Echocardiography*, *33*(12), 1454–1464.

Turkbey, E. B., Backlund, J.-Y. C., Gai, N., Nacif, M., Van der Geest, R. J., Lachin, J. M., Armstrong, A., Volpe, G. J., Nazarian, S., & Lima, J. A. C. (2022). Left Ventricular Structure, Tissue Composition, and Aortic Distensibility in the Diabetes Control and Complications Trial/Epidemiology of Diabetes Intervention and Complications. *The American Journal of Cardiology*, *174*, 158–165.

Vink, C. E. M., Woudstra, J., Lee, J. M., Boerhout, C. K. M., Cook, C. M., Hoshino, M., Mejia-Renteria, H., Lee, S. H., Jung, J.-H., & Echavarria-Pinto, M. (2023). Sex differences in prevalence and outcomes of the different endotypes of chronic coronary syndrome in symptomatic patients undergoing invasive coronary angiography: Insights from the global ILIAS invasive coronary physiology registry. *Atherosclerosis*, *384*, 117167.

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