Pre- and Post-Test Probability of Coronary CT Angiography in Obstructive Coronary Artery Diagnosis

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ABSTRACT

Aim: This study aimed to assess the change in the theoretical probability of obstructive coronary artery diseases in patients undergoing Coronary CT Angiography. among patients who presented with chest pain to Queen Alia Heart Institute’s Cardiology clinics, Royal Medical Services, Amman, Jordan between January 2020 to January 2021.

Methods: The pre-test probability of obstructive coronary artery diseases was determined for each patient using the predictive model of Genders, which is an updated and extended version of the previous model of Diamond and Forrester. The post-test probability was calculated for each patient using Bayes’ theorem, according to the equation: $P(A|B)=[P(B|A)\times P(A)]/P(B)$, in which P (A|B) is the post-test probability conditioned by the pre-test probability [P(A)] and P(B) is the probability determined by the test used. The receiver operating characteristic curve was thereafter used to evaluate the area under the receiver operating characteristic curve and performance indices of pre-test and post-test probabilities of CAD.

Results: The area under the curves were significantly higher for the pre-test Gender et al predictive model than post-test Gender et al model with Area±SEM of 0.902±0.006 (95% CI; 0.889-0.915) vs 0.798±0.010 (95% CI; 0.777-0.818), respectively. The Binary Logistic Regression of the two investigated prediction models against the stenosis probability of being ≥50% were formulated as [(Odd ≥50%=-5.362+0.087× Pre-test Gender et al probability) and (Odd of ≥50%=-21.61+0.256×Post-test Gender et al probability)].

Conclusion: The tested Jordanian patients' probabilities for having obstructive coronary artery diseases based on the extended and updated version of the Gender predictive model were undervalued after conditioning these patients' probabilities with the corresponding CT angiography-guided coronary obstructiveness percentages.

Keywords: Pre-Test probability; Post-Test probability; Obstructive coronary artery disease; Coronary CT angiography; Prediction models.

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INTRODUCTION

In clinical practice, patients with suspected coronary artery disease (CAD) can be often evaluated by using invasive and non-invasive diagnostic tests. Traditionally, an exercise ECG, supported by other functional tests such as stress echocardiography or myocardial perfusion scintigraphy, is usually considered the first line in this context of diagnostic plan. Since each diagnostic procedural test being either invasive or non-invasive, each has its pros and cons, so choosing the most beneficial diagnostic test for each patient is pivotal. [1-3]

From the departments of:
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In the recent years, coronary computed tomographic angiography (cCTA) has been increasingly used as a valid, reasonable, valuable, and affordable alternative, especially in patients with low-intermediate pre-test CAD risk probability. cCTA is a relatively safe non-invasive diagnostic procedure with a very high negative predictive value, making it especially valuable for ruling out obstructive CAD in the same session with a smaller procedural complication compared to invasive coronary angiography (ICA). [4-6]

The value of any diagnostic test depends on how the selected procedural findings will change the assessed patient's pre-test probability, ideally either increasing it to a level that justifies ICA or reducing it to a level where the diagnosis can be excluded. Thus, the proper assessment of the true CAD is extremely beneficial to appropriately allocate patients for the optimal diagnostic procedure with the highest expected clinical benefit. The calculation of pre-test probability (PTP) of disease can facilitate prioritizing higher-risk CAD patients for invasive diagnostic procedures. [7-8]

The Diamond-Forrester PTP calculation model was introduced in 1979 and is based on three clinical parameters that have to be assessed in each patient (patient's gender, age, and type of angina presentation). This original Diamond-Forrester PTP calculation model was statistically updated by Genders in 2011 to improve the prediction of obstructive CAD, especially in women and patients with atypical angina presentation. [9-10] . Our study aimed to assess the change in the theoretical probability of the Genders predictive model in patients undergoing cCTA as the first-line for patients who presented with clinical concerns for CAD to QAHI's Cardiology service between January 2020 to January 2021.

MATERIALS AND METHODS

This study was performed as a pilot retrospective study for patients with stable chest pain and intermediate risk of coronary artery disease and was conducted in patients clinically referred for CT which was performed at the department of Queen Alia Heart Institute. Patients with high-risk CAD or with documented CAD, particularly those with a history of myocardial infarction or revascularization, or coronary stenosis ≥50% on previous invasive coronary angiography were excluded from the study. We also excluded patients being not in sinus rhythm, or pregnant ladies, or on hemodialysisfrom the study cohort. Finally, all eligible patients with typical, atypical, and non-specific mild-moderate chest pain and who underwent coronary CT angiography were included in this retrospective study. Because of the retrospective nature of our research, a signed consent form was waived.

Based on the CTA result, studied patients were categorized into two primary cohorts; attended patients with typical, atypical, and non-specific mild-moderate chest pain and whose CTA stenosis <50% cohort (**Cohort I**) and attended patients with typical, atypical, and non-specific mild-moderate chest pain and whose CTA stenosis ≥50% cohort (**Cohort II**). We performed the statistical analysis by using SPSS version 25. A p-value of ≤ 0. 05 was defined to indicate statistical significance. Tested categorical variables were compared across the two cohorts via the Chi-Square test. Analyzed outcomes were presented as numbers (percentages), Pearson Chi-Square (χ 2) and Likelihood Ratio (**G^2**), odd ratio (OD), and the p-value.

The pre-test probability of obstructive CAD was determined for each patient using the predictive model of Genders et al., which is the updated and extended version of the previous model of Diamond and Forrester. The probability function, estimated by the logistic regression model used, is expressed as $f(z) = e^{-z} / (1 + e^{-z})$, in which z represents the contribution of each of the variables involved and is equal to $-4.37 + 0.04\times$age (in years) + 1.34 (in men) + 1.9 in the case of typical angina or 0.64 in the case of atypical angina. The typicality of angina presentation was based on the presence of the following three criteria: retrosternal localization of pain, precipitation by exertion, and prompt relief by rest or after nitroglycerin.

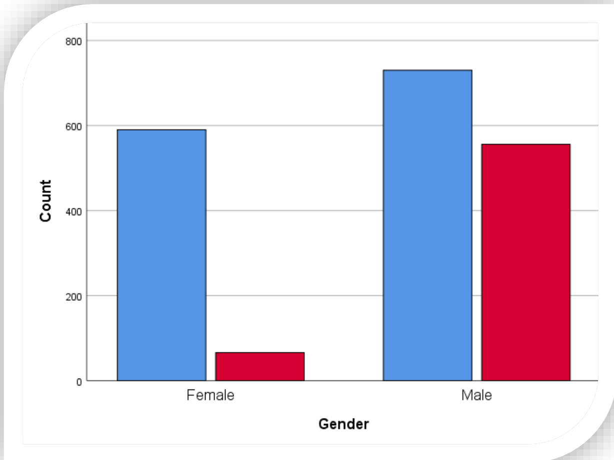
The post-test probability was calculated for each patient using Bayes' theorem, according to the equation: $P(A|B)=[P(B|A)\times P(A)]/P(B)$, in which P (A|B) is the post-test probability conditioned by the pre-test probability [P(A)] and P(B) is the probability determined by the test used. To compare the diagnostic accuracy of the pre-test predictive model of Genders et al versus CTA based post-test predictive model of Genders et al, we performed a logistic regression analysis with the outcome (CAD or no CAD) as a dependent variable. The receiver operating characteristic (ROC) curve was thereafter used to evaluate the AUROC and performance indices of pre-test and post-test probabilities of CAD. P-value < 0.05 was considered statistically significant. Confidence intervals of 95% were calculated. The analyses were done using SPSS (SPSS Statistics Version 25 IBM).

RESULTS

The ROC test was utilized to explore the area under the ROC curves (AUROCs) for the changes in the theoretical probability of the Genders predictive model in patients, who presented with stable chest pain, undergoing cCTA as the first-line at QAHI; the reference pre-test predictive Genders model (red color) versus the post-test probability of the Gender predictive model for the coronary artery obstructiveness percentage $\geq$ 50% (blue color). The AUROCs were significantly higher for the pre-test Gender predictive model than post-test Gender model with Area±SEM of 0.902±0.006 (95% CI; 0.889-0.915) vs 0.798±0.010 (95% CI; 0.777-0.818), respectively. The Receiver Operating Characteristic (ROC) test illustration was presented in Figure 2.

Table 1. Comparatively studied variables across stenosis grade cohorts who presented with stable chest pain to QAHI's Cardiology clinics, RMS, Amman, Jordan between 1 Jan 2020 to 1 Jan 2021						
	Stenosis grade<50% Cohort I (1320, 67.97%)	Stenosis grade≥50% Cohort II (622, 32.03%)	Total (N=1942)	χ^2 G^2	Odd ratio	p-Value
Gender						
Female	590 (44.7%)	66 (10.6%)	656 (33.8%)	219.595 248.181	6.81,95%CI; (5.16-8.98)	0.000
Male	730 (55.3%)	556 (89.4%)	1286 (66.2%)			
Female: Male	1.24: 1	8.42: 1	1.96: 1			
Age categorization						
18-29	123 (9.3%)	2 (0.3%)	125 (6.4%)	310.903 331.807	NA	0.000
30-39	337 (25.5%)	70 (11.3%)	407 (21.0%)			
40-49	451 (34.2%)	109 (17.5%)	560 (28.8%)			
50-59	295 (22.3%)	262 (42.1%)	557 (28.7%)			
60-69	76 (5.8%)	139 (22.3%)	215 (11.1%)			
>=70	38 (2.9%)	40 (6.4%)	78 (4.0%)			
Co-Morbidities						
<3	1203 (91.1%)	187 (30.1%)	1390 (71.6%)	775.077 767.490	23.92, 95% CI; (18.52-30.89)	0.000
>=3	117 (8.9%)	435 (69.9%)	552 (28.4%)			
Heart score MACE						
Low risk	1267 (96.0%)	238 (38.3%)	1505 (77.5%)	807.730 798.606	38.57, 95%CI; (28.04-53.06)	0.000
Moderate risk	53 (4.0%)	384 (61.7%)	437 (22.5%)			
Angina class						
Typical Chest Pain	409 (31.0%)	607 (97.6%)	1016 (52.3%)	752.826 932.276	NA	0.000
Atypical Chest Pain	468 (35.5%)	15 (2.4%)	483 (24.9%)			
Non-Specific Chest Pain	443 (33.6%)	0 (0.0%)	443 (22.8%)			
Pre-test stenosis %_Genders et al						
<50%	996 (75.5%)	61 (9.8%)	1057 (54.4%)	734.567 806.590	28.27, 95% CI; (21.10-37.88)	0.000
>=50%	324 (24.5%)	561 (90.2%)	885 (45.6%)			
Pre-test stenosis grade Genders et al						
Minimal 1%-24%	664 (50.3%)	0 (0.0%)	664 (34.2%)	856.698 1024.187	NA	0.000
Mild 25%-49%	332 (25.2%)	61 (9.8%)	393 (20.2%)			
Moderate 50%-69%	222 (16.8%)	200 (32.2%)	422 (21.7%)			
Severe >=70	102 (7.7%)	361 (58.0%)	463 (23.8%)			
Stenosis grade_CTA						
Minimal 1%-24%	433 (32.8%)	0 (0.0%)	433 (22.3%)	1942.000 2435.604	NA	0.000
Mild 25%-49%	887 (67.2%)	0 (0.0%)	887 (45.7%)			
Moderate 50%-69%	0 (0.0%)	622 (100%)	622 (32.0%)			
Genders et al Model vs CTA						
Under-Estimation	987 (74.8%)	101 (16.2%)	1088 (56.0%)	587.970 620.968	15.29, 95%CI; (11.95-19.57)	0.000
Over-Estimation	333 (25.2%)	521 (83.8%)	854 (44.0%)			

Data results of the comparative variables between the 2 tested cohorts were statistically analyzed by Chi-Square Test (at p-value< 0.05) and expressed as Numbers (Percentage). The strength of associations was also described as odd ratios (OR). The Pearson chi-square statistic (χ 2) involves the squared difference between the observed and the expected frequencies. The Goodness of Fit (G-Test of independence) uses the log of the ratio of two likelihoods and tests the goodness of fit of observed frequencies to their expected.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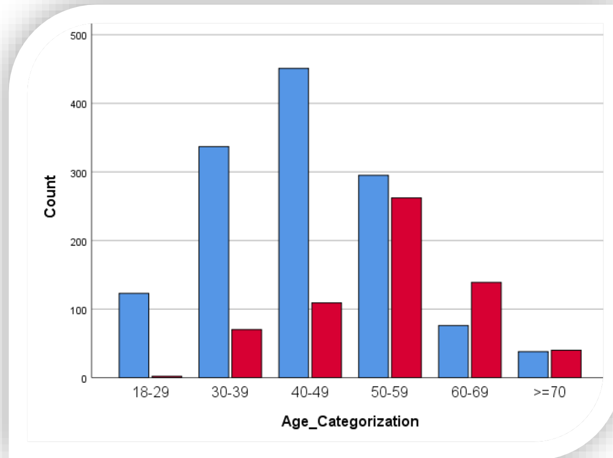
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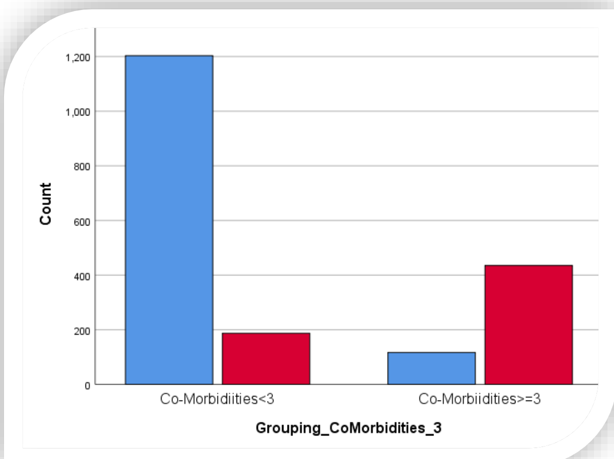
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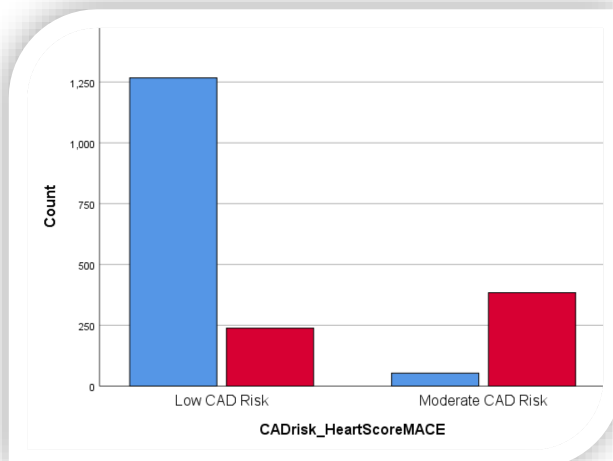
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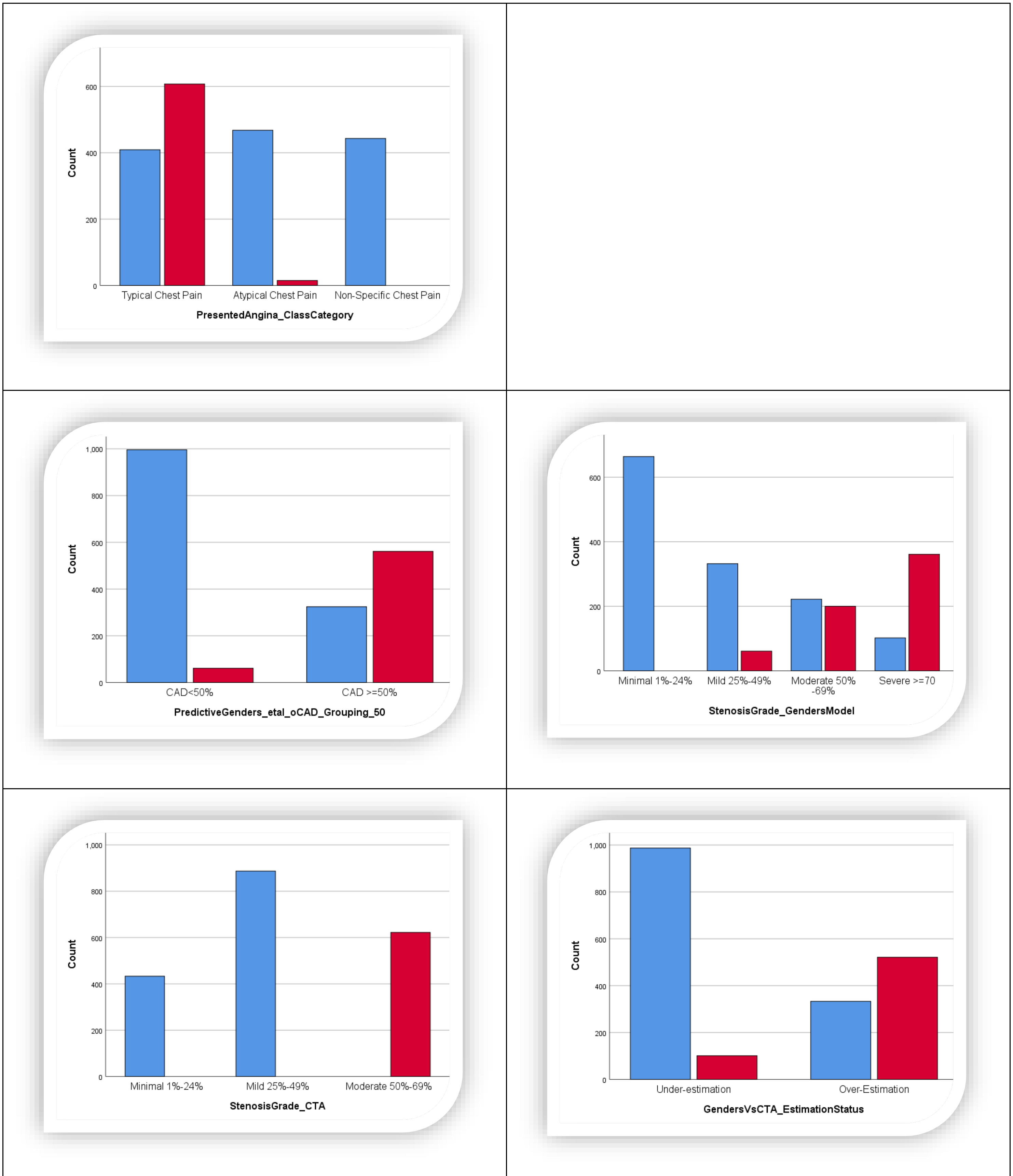


Fig 1. Bar charts illustrations for the tested variables across the two 2 tested cohorts; Attended patients with stable chest pain and whose coronary CT angiography stenosis was <50% (**Cohort I**) versus Attended patients with stable chest pain

and whose coronary CT angiography stenosis were ≥50% (**Cohort II**), for patients who presented to Queen Alia Heart Institute's Cardiology clinics, Royal Medical Services, Amman, Jordan between 1 Jan 2020 to 1 Jan 2021.

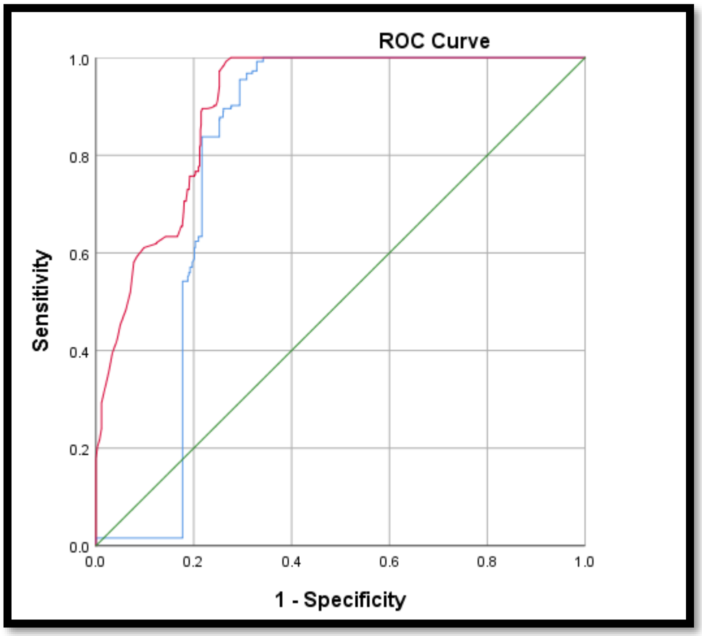


Fig 2. The Receiver Operating Characteristic (ROC) test was conducted to explore the area under the ROC curves (AUROCs) for the changes in the theoretical probability of the Genders et al predictive model in patients, who presented with stable chest pain, undergoing cCTA as the first-line at Queen Alia Heart Institute's Cardiology clinics, Royal Medical Services, Amman, Jordan between 1 Jan 2020 to 1 Jan 2021; the reference pre-test predictive Genders et al model (red color) versus the post-test probability of the Gender et al predictive model for the coronary artery obstructiveness percentage ≥ 50% (blue color). The AUROCs were significantly higher for the pre-test Gender et al predictive model than post-test Gender et al model with Area±SEM of 0.902±0.006 (95% CI; 0.889-0.915) vs 0.798±0.010 (95% CI; 0.777-0.818), respectively.

Table 2. The Binary Logistic Regression analysis for the changes in the theoretical probability (Pre-test vs Post-test) of the Genders et al predictive model in patients, who presented with stable chest pain, undergoing cCTA as the first-line at Queen Alia Heart Institute's Cardiology clinics, Royal Medical Services, Amman, Jordan between 1 Jan 2020 to 1 Jan 2021.

Tested predictors	B±SEM	Wald	Sig.	Exp (B)	95% C.I.for EXP(B)		χ^2 (df)	Variation range	%Cases
					Lower	Upper			
oCAD≥50%	**e (-5.362+0.087×Pre-test Gender et al)/[1+ e (-5.362+0.087×Pre-test Gender et al)]**								
Pre-test	0.087±0.004	469.534	0.000	1.091	1.082	1.099	**(8)** 218.339	41.1%-57.9%	78.4%
Constant	-5.362±0.253	449.655	0.000	0.005					
oCAD≥50%	**e (-21.61+0.256×Post-test Gender et al)/[1+ e (-21.61+0.256×Post-test Gender et al)]**								
Post-test	0.256±0.013	359.156	0.000	1.292	1.258	1.326	(8) 621.504	30.1%-42.1%	73.5%
Constant	-21.61±1.127	367.530	0.000	0.000					

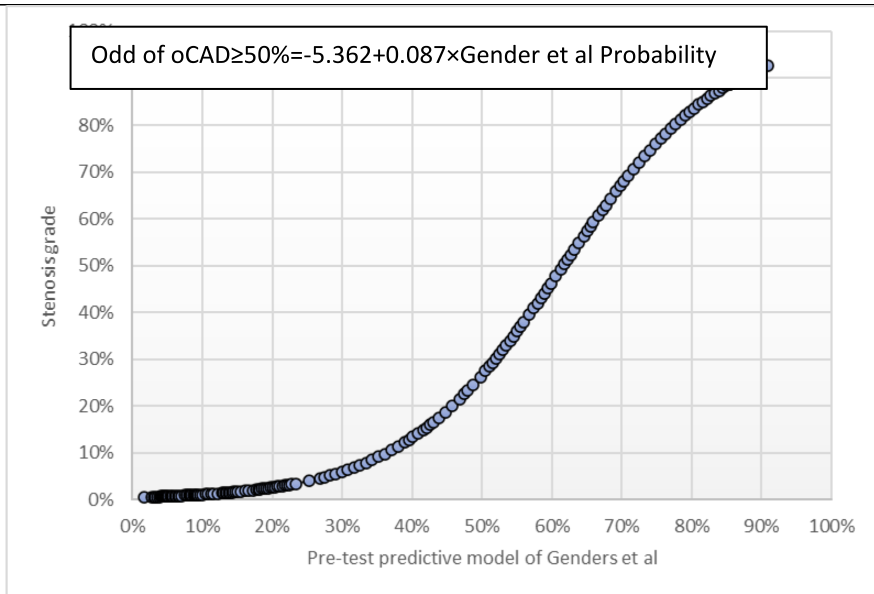
- The Binary Logistic Regression analysis was conducted for the 2 tested predictive obstructive coronary artery disease (oCAD) models; The reference tested predictive Genders et al model and our constructed Multiple Logistic Regression (MLgR) predictive models, against oCAD≥50% as documented by the coronary CT angiography.
- The Binary Logistic Regression Test was conducted to explore the degree of correlations, how much of the total variations in the dependent variable can be explained by the independent variables, and the quality of the prediction of the dependent variable.

Table 3. The optimal cut-off points, sensitivities, specificities, positive and negative predictive values, likelihoods ratios, and Youden and accuracy indices for the changes in the theoretical probability (Pre-test vs Post-test) of Genders et al predictive model in patients, who presented with stable chest pain, undergoing cCTA as the first-line at Queen Alia Heart Institute's Cardiology clinics, Royal Medical Services, Amman, Jordan between 1 Jan 2020 to 1 Jan 2021.

Prognostic Indicator	Cutoff	TPR	FPR	YI	TNR	PPV	NPV	NLR	PLR	AI
Pre-test	40.855%	99.2%	26.6%	72.61%	73.41%	63.74%	99.49%	1.10%	373.05%	81.67%
Post-test	78.87%	99.2%	32.9%	66.32%	67.12%	58.71%	99.44%	1.20%	301.70%	77.39%

• The area under the receiver operating characteristic (ROC) analysis was constructed for the changes in the theoretical probability of the Genders et al predictive model in patients, who presented with stable chest pain, undergoing cCTA as the first-line at Queen Alia Heart Institute's Cardiology clinics, Royal Medical Services, Amman, Jordan between 1 Jan 2020 to 1 Jan 2021; the reference pre-test predictive Genders et al model versus the post-test probability of the Gender et al predictive model for the coronary artery obstructiveness percentage ≥ 50%; oCAD<50% (0) vs oCAD≥50% (1). The sensitivity analysis was thereafter processed on a total of 1942 processed cases; 622 cases were processed as positive actual state, 1320 cases were processed as negative actual state, and 0 cases were treated as missing data. Higher values of the test result variable(s) indicate stronger evidence for a positive actual state. The positive actual state in our study was set for the oCAD probability was ≥50%.

- TPR: True positive rate (sensitivity).
- FPR: False positive rate.
- YI: Youden index.
- TNR: True negative ratio (specificity).
- NLR: Negative likelihood ratio.
- PPV: Positive predictive value.
- NPV: Negative predictive value.
- AI: Accuracy index.
- PLR: Positive likelihood ratio.



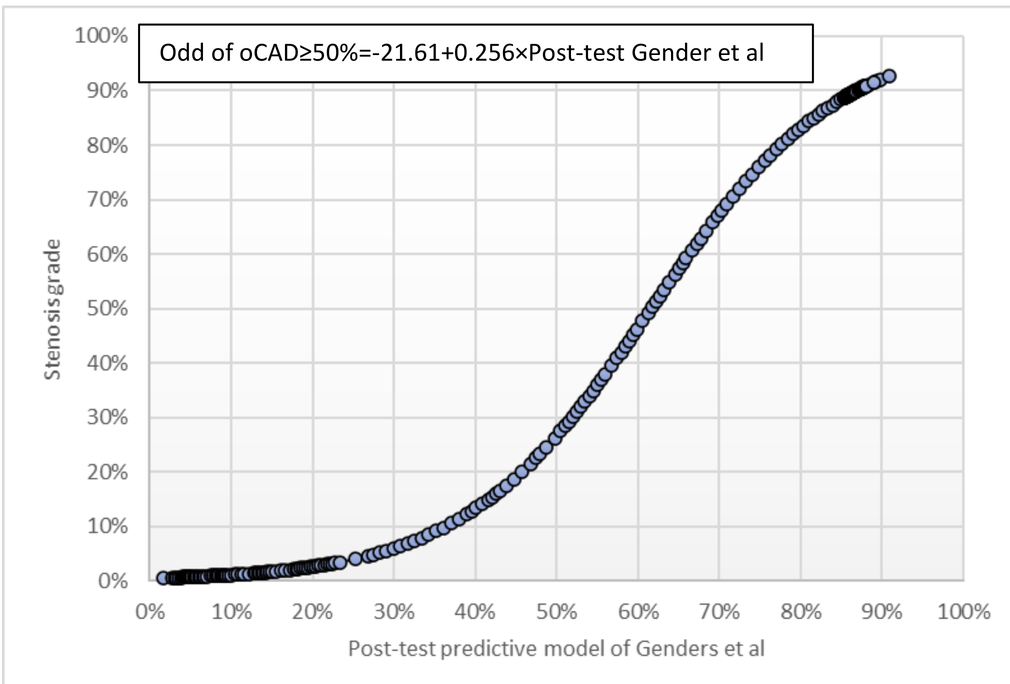


Fig 3. The Binary Logistic Regression illustrations for the changes in the theoretical probability of Genders et al predictive model in patients, who presented with stable chest pain, undergoing cCTA as the first-line at Queen Alia Heart Institute's Cardiology clinics, Royal Medical Services, Amman, Jordan between 1 Jan 2020 to 1 Jan 2021. the reference pre-test predictive Genders et al model versus the post-test probability of the Gender et al predictive model for the coronary artery obstructiveness percentage ≥ 50%; oCAD<50% (0) vs oCAD≥50% (1)

he Binary Logistic Regression of the two investigated prediction models against the stenosis probability of being ≥50% were formulated as [(Odd of oCAD≥50%=-5.362+0.087× Pre-test Gender probability) and (Odd of oCAD≥50%=-21.61+0.256×Post-test Gender probability)]. The Binary Logistic Regression analysis results and illustrations were fully described in Table 2 and Figure 3.

The sensitivity analysis was thereafter formulated on a total of 1942 processed cases; 622 cases were processed as positive actual state, 1320 cases were processed as negative actual state, and 0 cases were treated as missing data. Higher values of the test result variable(s) indicate stronger evidence for a positive actual state. The positive actual state in our study was set for the oCAD probability was ≥50%. The sensitivity indices' results for the changes in the theoretical probability (Pre-test vs Post-test) of the Genders predictive model, including sensitivity, youden's index, specificity, positive and negative predictive values, negative and positive likelihood ratios, and accuracy index, were 99.2%, 72.61%, 73.41%, 63.74%, 99.49%, 1.10%, 373.05%, and 81.67% versus 99.2%, 66.32%, 67.12%, 58.71%, 99.44%, 1.20%, 301.70%, and 77.39%, respectively. The explored optimal operating cutoff points for the 2 investigated predictive models in our study were 40.85% and 78.87%, respectively.

The overall tested gender ratio (male to female ratio) in this study was assigned to 1.96: 1 with significant distributions across Cohort I-II [1.24: 1 and 8.42: 1, respectively]. Regarding the tested patients' age categorization, the age range (40-49) years and (50-59) years had significantly the highest proportional distribution among the other age range categories [560 (28.8%) and 557 (28.7%), respectively] followed by age ranges of (30-39) years and (60-69) years [407 (21.0%) and 215 (11.1%), respectively].

The overall heart score risk was higher for lower risk cohort compared to the moderate risk cohort [1505 (77.5%) vs 437 (22.5%)] with significant distribution across the 2 comparative groups [1267 (96.0%) vs 53 (4.0%) and 238 (38.3%) vs 384 (61.7%), respectively] Also, the overall co-morbidity burden was higher for lower burden (<3 co-morbidity number) compared to higher burden (≥3 co-morbidity number) [1390 (71.6%) vs 552 (28.4%), respectively] with significant distribution across the Cohort I-II [1203 (91.1%) vs 117 (8.9%) and 187 (30.1%) vs 435 (69.9%), respectively].

The presented chest pain classes for the attended tested patients were highest for the typical class followed by atypical and lastly by the non-specific chest pain class [1016 (52.3%) vs 483 (24.9%) vs 443 (22.8%), respectively] with significant distributions across the 2 tested comparative groups [409 (31.0%), 468 (35.5%), and 443 (33.6%) vs 607 (97.6%), 15 (2.4%), and 0 (0.0%), respectively].

The tested patients' oCAD risks based on the Gender model had significant distributions across the 2 categorized cohorts [664 (50.3%), 332 (25.2%),222 (16.8%), and 102 (7.7%) vs 0 (0.0%), 61 (9.8%), 200 (32.2%), and 361 (58.0%), respectively] for the estimated obstructiveness of coronary arteries of 1%-24% (Minimal), 25%-49% (Mild), 50%-69% (Moderate), and >=70 (Severe), respectively.

The tested patients had significant stenosis grade distributions across Cohort I-II [433 (32.8%), 887 (67.2%), and 0 (0.0%) vs 0 (0.0%), 0 (0.0%), and 622 (100%), respectively] for which the Gender et al predictive model had an under-estimation propensity of 1088 (56.0%) and an over-estimation propensity of 854 (44.0%) when compared with the referenced oCAD' s diagnostic test in this study (CTA), that were significantly distributed across Cohort I-II [987 (74.8%) and 333 (25.2%) vs 101 (16.2%) and 521 (83.8%), respectively].

Comparably, our proposed MLgR predictive model had a higher under-estimation probability when compared to the comparative referenced Gender model [1330 (68.5%) vs 1088 (56.0%), respectively]. On the other hand, our proposed MLR model had a lower over-estimation probability compared to the Gender model [533 (27.4%) vs 854 (44.0%), respectively]. Interestingly, our proposed model had a matched probability of 4.1% (79 cases) in regards to the CTA reference. The comparatively studied variables and the bar charts' visualizations for the studied patients across Cohort I-II were summarized in Table 1 and Figure 1.

DISCUSSION

Owing up to maximally 41% of oCAD' suspected patients who underwent elective ICA will have a confirmed oCAD diagnosis, most cardiovascular guidelines, including the European and American guidelines, galvanize the practical mandatory for the initial pre-testing and risk discrimination of the attended patients with stable chest pain before advancing into higher levels of non-invasive and invasive diagnostic procedures. [11-12]

Because decisions on diagnostic testing are usually made before CTA is performed, the clinical usefulness of diagnostic test-based CTA, in particular, the coronary calcium score is limited. As CTA has a high sensitivity/ specificity with a reasonable overall diagnostic performance for significant oCAD, we used CTA results equally as ICA results in this study. If ICA was followed after CTA, the ICA result was selected for the final post-test analysis. If the CTA was performed without ICA following, we consider the CTA results for the post-test estimation of the investigated predictive model of the Gender model. In this study, only 17.2% of the all-eligible investigated patients (327 cases) followed by ICA confirmation procedure after the initial CTA procedure, while 82.8% (1579 cases) underwent only CTA diagnostic procedure. Of note, the CTA results were visually and quantitatively assessed by qualified and trained specialists for CTA and cardiologists. [13-14]

Although the extended and updated version of the D-F predictive model, the Gender model, was originally constructed in a population with a high prevalence of oCAD and who underwent ICA, it was validated in a population with a low prevalence of CAD and who underwent CTA. Depending on these explored predictive models, as recommended by NICE chest pain guidelines, the conclusions of pre-test and/ or post-test calculations may result in up to 2/3 of the triaged patients being excluded from further advanced cardiac investigations. While the Gender predictive model was considered as the extended and updated multiple logistic version of the D-F predictive model, the D-F model was primarily constructed more than 30 years ago on United State populationwhose ages ranged between 30-70 years, which raises the debate regarding its generalizability in the Jordanian cohort whose attended chief complaint is substernal chest pain. In this study, we investigated that the valid Gender predictive model had AUROCs significantly higher for the pre-test Gender predictive model than the post-test Gender model with Area±SEM of 0.902±0.006 (95% CI; 0.889-0.915) vs 0.798±0.010 (95% CI; 0.777-0.818), respectively. [15-16]

To the best of our knowledge, recent data for affected oCAD patients from a large-volume center over 5 years in Portugal revealed that approximately 43% of 1892 patients undergoing diagnostic CTA didn't have oCAD. And wider use of Bayes theorem-based CTA constructed probabilistic models, when used appropriately, could help in minimizing this practical issue. [17-18] Additionally, the results of our study support the latest and updated clinical guidelines for the stable oCAD diagnosis, especially with the UK National Institute for Health and Clinical Excellence (NICE), which propose diagnostic CTA in patients with a pre-test probability of coronary stenosis of

10–29%, ischemia imaging for those with a pre-test probability of 30–60%, and direct referral for ICA in those with a pre-test probability of >60%. [19-22]

The fact that the CTA procedure has some access restrictions, relatively higher cost-related expenditures, and possible ionizing radiation and iodinated contrast risk to the employees, its clinical utilities, and cost-effectiveness had been a subject of debate. [23-24] It should be borne in mind that the predictive performance of the Gender model was undervalued in our study after the estimated Gender based pre-test probabilities of the tested Jordanian cohort were conditioned by the CTA-guided coronary obstructiveness percentages.

Our study had certain limitations. First, it was essentially dependent on certain assumptions, particularly in terms of the sensitivity (98%) and specificity (85%) of the CTA which was retrieved from the Ollendorf metanalysis. [25] Second, only 17.2% of the all-eligible investigated patients (327 cases) in this study were followed by an ICA confirmation procedure after the initial CTA procedure, it was not possible to assess the true sensitivity and specificity of each of the tests in this population. Third, the sample may not have been representative of all Jordanian population with suspected oCAD, since generalizing conclusions from this study should be considered with caution. Last, it should also be borne in mind that the CTA procedure's functional and anatomical findings do not necessarily correlate closely with the patients' attended symptoms. Large-sample, multiinstitutional, and prospective studies are needed to identify the post-test probability after conditioning predictive model pre-test probability by the CTA obstructiveness percentages.

CONCLUSIONS

In our study, we demonstrated that the CTA procedure reduced the predictive probability performances of the validated and the guidelines approved pre-test predictive model of oCAD. So, depending on pre-test probability of coronary stenosis between 10%-29% may be the optimal eligibility for pursuing CTA diagnostic procedures.

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