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ORIGINAL ARTICLE

# Vascular access and angiographic lesion morphology in elective percutaneous coronary intervention

Osama Tayeh [a,*], Federica Ettori [b]

[a] *Critical Care Department, Faculty of Medicine, Cairo University, Egypt*
[b] *Cardiothoracic Department, Spedali Civili, Brescia University, Italy*

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**Abstract** Many coronary interventionists have a perception that the radial route may not facilitate complex PCI. This study evaluates the association between target lesion morphology, vessel characteristics and angiographic outcome in elective PCI cases carried out through radial versus femoral artery approach.
*Methods:* Elective PCI cases over a 23 month period at a tertiary care hospital were reviewed for this analysis. Modified ACC/AHA classification was used to ascertain the impact of different arterial accesses in elective PCI on the angiographic outcome with the complex angiographic lesion morphologies.
*Results:* 343 Patients and 407 lesions were analyzed. Radial access was the final route in 253 procedures treating a total of 300 lesions, while femoral access was the final route in 90 PCI procedures for treating 107 lesions. Lesion complexity incidence in radial PCI group by using modified ACC/AHA classifications A, B1, B2, and C were 4.67%, 15%, 60.33% and 20%, respectively. While in the femoral PCI, the incidence of lesion types was 6.54%, 15.89%, 42.99%, and 34.58%, respectively. By summation of the complex end of the spectrum for ACC/AHA lesion types B2 plus C, the incidence was 241 lesions (80.33%) in radial PCI vs. 83 lesions (77.57%) in femoral PCI, $P = 0.25$. Angiographic successful outcome according to the combined end point was achieved in 283 lesions (94.33%) for radial PCI vs. 92 lesions (85.99%) in femoral PCI, $P = 0.004$.
*Conclusion:* This study confirms that a default radial PCI is an effective strategy for the majority of complex lesions in elective PCI.


* Corresponding author. Address: Critical Care Medicine Department, kasr Elini hospital, Cairo University, Egypt. Mobile: +20 1005012070.
E-mail address: osama_tayeh@hotmail.com (O. Tayeh).
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## 1. Introduction

Heterogeneity of the composition, distribution, and location of atherosclerotic plaque within the native coronary artery results in unique patterns of stenosis morphology in patients with coronary artery disease (CAD). These patterns have been used to identify risk factors for procedural outcome and complications after percutaneous coronary intervention (PCI).[1] Many

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studies[2–5], have confirmed that complex coronary lesions remain predictive of adverse events after PCI, such as abrupt vessel closure, primarily due to thrombus or dissection which were reported in 3–8% of patients and were associated with certain lesion characteristics.[6–8] Also the type of lesion attempted to strongly influence the success rate, as the chance of dilating a chronic total occlusion averages 65%, and specific clinical and anatomic factors that affect this rate have been identified .[9] Quite different is the success rate for total occlusion associated with ST-segment elevation myocardial infarction (STEMI), success rate over 90% can be expected in this subgroup.[10] In PCI, the landmark ACCESS study demonstrated fewer major access site complications for radial compared to other access routes.[11] Despite a perception among some operators that the radial route may not facilitate complex PCI, experienced radial operators claim few practical limitations with the technique.[12] Small studies suggest that radial route can support complex PCI in selected cases.[13,14] The extent to which radial access may be a limiting factor in contemporary PCI is yet to be quantified, and the interplay between complex lesion morphology and angiographic outcome in elective radial access PCI has not been evaluated in wide scale. This study evaluates the association between target lesion morphology, vessel characteristics and angiographic outcome in elective PCI cases carried out by radial artery versus femoral artery approach.

## 2. Methods

All cases of elective PCI over a 23 month period (starting from March 2007 till the end of January 2009) at a tertiary care hospital (Cardiothoracic department, Spedali Civili, Brescia University, Italy) were reviewed for this analysis. All the data were entered into a database detailing arterial access route, target vessel and lesion characteristics, and angiographic success or failure on a lesion-by-lesion basis after the end of each procedure.

Criteria established by a joint American college of cardiology/American heart association task force (ACC/AHA) suggested that procedure success and complication rates were related to a number of different lesion characteristics.[15] Over the decade following the publication of these criteria, despite substantial improvements in the techniques used for coronary intervention, the most complex lesion morphologies (i.e., "type C" lesions) remain associated with reduced procedural success in patients with ischemic CAD.[16]

Therefore, we applied the vessel and lesion characteristics according to modified ACC/AHA classification of the primary target stenosis with type B divided into type B1 (one adverse characteristic of type B characteristics) and type B2 (⩾2 adverse characteristic of type B characteristics), on the basis of prior work suggesting the cumulative importance of multiple adverse lesion characteristics (Table 1 and 2).[17–21].

Coronary Interventions were carried out by the authors who reported lesion characteristics and outcomes according to a standard template, which was created prospectively at the time of database record creation. Modified ACC/AHA classification was used to ascertain the impact of different arterial accesses in elective PCI on the angiographic outcome with the complex angiographic lesion morphologies.

The study population was stratified according to arterial access used to perform elective PCI into two groups; radial group and femoral group. The choice between femoral or radial artery access was left to the discretion of the operator. The radial approach is the default strategy at the Brescia catheterization laboratory – Spedali Civili.

Clinical variables such as were assessed age, gender, smoking, diabetes mellitus, hypertension, dyslipidemia, and prior myocardial infarction. Angiographic outcome was recorded as successful if the visual angiographic estimate of residual coronary stenosis was < 20% in stented segments or < 50% in balloon angioplasty segments, with the presence of TIMI III flow in the target vessel on a lesion-by-lesion basis.[1,22]

## 3. Statistical analysis

Data were coded and computed on a statistical package for social sciences SPSS version 17 for windows for statistical analysis. PCI cases undertaken were evaluated on grounds of lesion characteristics and lesion-specific angiographic

**Table 1** American College of Cardiology/American Heart Association Task Force (ACC/AHA) classification of the primary target stenosis. From Ryan TJ et al.[15]

| | |
|---|---|
| *Type A Lesions (high success, 85%; low risk)* | |
| - Discrete (< 10 mm length) | - Little or no calcification |
| - Concentric | - Less than totally occlusive |
| - Readily accessible | - Not ostial in location |
| - Non angulated segment, < 45° | - No major branch involvement |
| - Smooth contour | - Absence of thrombus |
| *Type B Lesions (moderate success, 60–85%; moderate risk)* | |
| - Tubular (10–20 mm length) | - Moderate to heavy calcification |
| - Eccentric | - Total occlusion < 3 months old |
| - Moderate tortuosity of proximal segment | - Ostial in location |
| - Moderately angulated segment, > 45°, < 90° | - Bifurcation lesions requiring double guide wires |
| - Irregular contour | - Some thrombus present |
| *Type C Lesions (low success, 60%; high risk)* | |
| - Diffuse (> 2 cm length) | - Total occlusion > 3 months old |
| - Excessive tortuosity of proximal segment | - Inability to protect major side branches |
| - Extremely angulated segments > 90° | - Degenerated vein grafts with friable lesions |

**Table 2** Angiographic definitions and variables. From Popma JJ et al.[16]

| Feature | Definition |
|---|---|
| Normal reference diameter | Diameter of normal-appearing lumen within the same coronary segment (may require averaging proximal and distal to lesion); if no normal area in the same segment, may be measured from adjacent segment providing no side branch $\geqslant$ 1.5 mm is interposed |
| Number of lesions | $\geqslant$50% Diameter stenosis in the target vessel |
| Number of diseased vessels | Number of coronary arteries with $\geqslant$ 50% diameter stenosis (left anterior descending, circumflex, or right coronary arteries; or bypassable branches thereof) |
| Eccentricity | Stenosis that is noted to have one of its luminal edges in the outer one quarter of the apparent normal lumen |
| Irregularity | Characterized by lesion ulceration, intimal flap, aneurysm, or saw-toothed pattern |
| - *Ulceration* | Lesions with a small crater consisting of a discrete luminal widening in the area of the stenosis |
| - *Intimal flap* | A mobile, radiolucent extension of the vessel wall into the arterial lumen |
| - *Aneurysm* | Segment of arterial dilation larger than the dimensions of the normal arterial segment |
| - *Saw toothed pattern* | Multiple, sequential stenosis irregularities |
| Length | Measured "shoulder to shoulder" in an unforeshortened view |
| - *Discrete* | Lesion length < 10 mm |
| - *Tubular* | Lesion length 10–20 mm |
| - *Diffuse* | Lesion length > 20 mm |
| Ostial location | Origin of the lesion within 3 mm of the vessel origin |
| Angulation | Vessel angle formed by the center line through the lumen proximal and distal to the stenosis |
| - *Moderate* | Lesion angulation $\geqslant$ 45 degrees |
| - *Severe* | Lesion angulation $\geqslant$ 90 degrees |
| Bifurcation stenosis | Stenosis involving the parent and daughter branch if a medium or large branch (> 1.5 mm) originates within the stenosis and if the side branch is completely surrounded by stenotic portions of the lesion to be dilated |
| Proximal tortuosity | |
| - *Moderate* | Lesion is distal to two bends > 75 degrees |
| - *Severe* | Lesion is distal to three bends > 75 degrees |
| Filling defect | An angiographic lucency, usually globular, with contrast surrounding at least 3 sides (or equivalent), divided into 3 grades: 1 = haziness alone, 2 = defect 1–2 mm, 3 = defect > 2 mm in diameter. |
| Degenerated SVG | Graft characterized by luminal irregularities or ectasia constituting > 50% of the graft length. |
| Calcification | Readily apparent densities noted within the apparent vascular wall at the site of the stenosis. |
| Total occlusion | TIMI 0 or 1 flow |
| Thrombus | Discrete, intraluminal filling defect is noted with defined borders and is largely separated from the adjacent wall. Contrast staining may or may not be present. |

outcome. Continuous data were analyzed using a Student's *t* test and presented as mean ± SD. Categorical data are presented as a percentage, and were analyzed using a chi squared analysis. Significance was defined as $P < 0.05$.

## 4. Results

Baseline patient's demographics for the total population studied are provided in Table 3. Three hundred and forty-three patients and 407 lesions in total were analyzed. Default radial access was primarily intended for 260 PCI procedures, but radial access was the final route in 97.2% of procedures ($n = 253$) treating a total of 300 lesions due to failed radial artery cannulation in 7 patients (2.8%), with cross over to femoral artery. Default femoral approach was intended in 83 PCI procedures, which succeeded in 98.9% of the cases with access failure in one patient (1.1%), and cross over to the contra-lateral femoral artery. Femoral access was the final route in 90 PCI procedures for treating 107 lesions, as 7 patients from the radial group were shifted to the femoral group. There was no statistical significant difference between the two groups regarding age, gender, and incidence of diabetes, stroke, hypertension, smoking, or dyslipidemia, but the incidence of prior coronary artery bypass grafting (CABG) and previous myocardial infarction were significantly higher in the femoral group.

In accordance with institutional policy, the femoral approach was favored for patients with negative findings on the Allen test,[23,24] and for patients with a coronary bypass graft. Elective femoral PCI was done in 17 bypass graft lesions (15.89%) vs. 2 bypass graft lesions (0.67%) in the radial group, $P = 0.000$. Left radial approach was used in those two patients, as they have peripheral vascular disease in the lower limbs.

Three hundred and three (74.45%) bare metal stents (BMS) and 41 (10.07%) drug eluting stents (DES) were deployed (A total of 344 stents) for both r-PCI and f-PCI. In the radial group 232 BMS (77.33%) were deployed vs. 71 BMS (66.36%) in the femoral group, $P = 0.32$. Sixteen DES (5.33%) vs. 25 DES (23.36%) were deployed in radial and femoral groups respectively ($P = 0.023$). Balloon angioplasty was done in 47 lesions (11.55%) for both groups. Thirty-six angioplasties were performed (12%) in the radial group vs. 11 angioplasties (10.28%) in f-PCI, $P = 0.15$.

Lesion complexity incidence in the radial PCI group by using modified ACC/AHA classifications A, B1, B2, and C was 4.67%, 15%, 60.33% and 20%, respectively. While in the femoral PCI, lesion types were 6.54%, 15.89%, 42.99%,

**Table 3** Patient demographics.

| | Radial PCI(N = 253) | Femoral PCI(N = 90) | P value |
|---|---|---|---|
| *Age (y.):* range | 31–88 | 35–89 | 0.192 |
| Mean ± SD | 65.17 ± 10.98 | 68.06 ± 10.19 | |
| *Sex, n (%):* | | | |
| Male | 192 (75.89%) | 62 (68.89%) | 0.256 |
| Female | 61 (24.11%) | 28 (31.11%) | |
| *Height (cm):* | | | |
| range | 153–189 | 148–190 | 0.149 |
| Mean ± SD | 168.35 ± 9.70 | 166.82 ± 7.87 | |
| *Weight (kg):* | | | |
| range | 48–140 | 43–120 | 0.354 |
| Mean ± SD | 76.52 ± 15.21 | 74.96 ± 13.37 | |
| *BSA($m^2$):* | | | |
| range | 1.63–2.39 | 1.62–2.29 | 0.262 |
| Mean ± SD | 1.85 ± 0.21 | 1.83 ± 0.19 | |
| Diabetes mellitus, n (%) | 177 (69.96%) | 67 (74.44%) | 0.239 |
| Hypertension, *n* (%) | 179 (70.75) | 58 (64.44%) | 0.491 |
| Dyslipidemia, *n* (%) | 112 (44.27%) | 45 (50.0%) | 0.134 |
| Cerebrovascular disease, *n* (%) | 10 (3.95%) | 6 (6.67%) | 0.195 |
| Smoking, *n* (%) | 136 (53.75%) | 53 (58.88%) | 0.437 |
| Previous CABG, *n* (%) | 2 (0.79%) | 17 (18.89%) | 0.000 |
| Previous MI, *n* (%) | 63 (24.90%) | 35 (38.89%) | 0.021 |

PCI = Percutaneous coronary intervention; BSA = Body surface area; MI = myocardial infarction; CABG = Coronary artery bypass grafting.

and 34.58%, respectively. A greater proportion of the femoral PCI were type C lesions ($P = 0.010$), while a greater proportion of lesions treated via the radial route were type B2 morphology ($P = 0.000$), Table 4. The incidence of type B2 plus C was 241 lesions (80.33%) in r-PCI vs. 83 lesions (77.57%) in f-PCI, $P = 0.25$.

TIMI flow III Post PCI was achieved in 287 lesions (95.67%) in the radial group vs. 100 lesions (93.46%) in the femoral group ($P = 0.364$). Residual stenosis < 20% in stented segments or < 50% in balloon angioplasty segments was achieved in 284 lesions (94.67%) in the radial group vs. 92 lesions (85.99%) in the femoral group ($P = 0.004$). Angiographic successful outcome according to the combined end point (residual coronary stenosis < 20% in stented segments or < 50% in balloon angioplasty segments, with the presence of TIMI flow III) was achieved in 283 lesions (94.33%) for radial PCI vs. 92 lesions (85.99%) in femoral PCI, $P = 0.004$.

Failed PCI in both groups were encountered in 17 lesions in r-PCI (5.67%) vs. 15 lesions in f-PCI (14.01%), $P = 0.004$. ACC/AHA lesion types of the failed PCI were B1, B2 and C with the following incidence: 2 lesions (0.67%), 4 lesions (1.33%), 11 lesions (3.67%) in r-PCI group, vs. 1 lesion (0.93%), 1 lesion (0.93%), 13 lesions (12.5%) in f-PCI group, respectively. There is a significant difference only in failed PCI for lesion type C, which was higher in f-PCI ($P = 0.03$). Failed PCI in the femoral group consisted of 5 lesions (4.67%) in venous bypass grafts and 10 lesions (9.34%) in native coronary arteries, while all the failed PCI in the radial group were in native coronary arteries.

Radial group had 35 lesions (11.66%) with total occlusion vs. 19 lesions (17.75%) in the femoral group, and angiographic success rate was achieved in 21 lesions (60%) in radial PCI vs. 11 lesions (57.89%) in the femoral group, $P = 0.43$.

## 5. Discussion

The primary intention of this analysis was to evaluate angiographic success or failure in the context of lesion and target vessel complexity among default radial operator cases. Radial access has dramatically changed the experience of PCI, for patients and their cardiologists. Although radial access is becoming the default approach for many cardiologists, arterial access route has not merited specific attention in either the American or European guidelines on PCI.[1,25]

Radial artery access has been associated with a greater access crossover rate, which is reported to be 4–7% in previous studies.[26–28] The crossover from radial to femoral approach occurred in 7 patients (2.77%) in our study in the radial group, while in the femoral group, there was one patient (1.1%) with cross over to contra-lateral femoral artery, ($P = 0.21$). Roberts et al.[29] reported the incidence of the cross over from radial to femoral access to be 1% in his study, which is a low cross over rate. He attributed this level of success to the accurate selection of suitable radial cases and the use of specific techniques, careful guide catheter choice, methods for dealing with tortuous subclavian anatomy, and specific guide catheter manipulation techniques have also developed alongside increasing use of radial access, and reflect the practice of high volume experienced radial operators.

The lesions treated via radial access were at the complex end of the spectrum of ACC/AHA with an incidence of 4.67%, 15%, 60.33% and 20% for lesions types A, B1, B2, and C respectively. Also the incidence in femoral PCI was 6.54%, 15.89%, 42.99%, and 34.58% for lesion types A, B1, B2, and C respectively. Type B2 lesions show a significant greater proportion in cases treated via radial approach, while a greater significant proportion of type C lesions were treated via femoral

**Table 4** Procedural characteristics.

| | Radial PCI | Femoral PCI | P value |
|---|---|---|---|
| Vascular access crossover, *n* (%) | 7 pts (2.77%) | 1 pt (1.1%) | 0.21 |
| *Vessels intervened upon, n (%):* | | | |
| One vessel | 214 pts (84.58%) | 75 pts (83.33%) | 0.726 |
| Two vessels | 31 pts (12.25%) | 13 pts (14.44%) | 0.802 |
| Three vessels | 8 pts (3.17%) | 2 pts (2.23%) | 0.707 |
| *Lesions intervened upon, n (%):* | | | |
| Left main artery | 2 (0.67%) | 3 (2.80%) | 0.086 |
| Left anterior descending artery | 108 (36.00%) | 32 (29.91%) | 0.237 |
| Left circumflex artery | 75 (25.00%) | 22 (20.56%) | 0.339 |
| Right coronary artery | 113 (37.66%) | 33 (30.84%) | 0.190 |
| Bypass graft | 2 (0.67%) | 17(15.89%) | 0.000 |
| *Modified ACC/AHA classification, n (%):* | | | |
| Type A Lesion | 14 (4.67%) | 7 (6.54%) | 0.494 |
| Type B1 Lesion | 45 (15%) | 17 (15.89%) | 0.560 |
| Type B2 Lesion | 181 (60.33%) | 46 (42.99%) | 0.000 |
| Type C Lesion | 60 (20%) | 37 (34.58%) | 0.010 |
| *Pre PCI TIMI flow grade, n (%):* | | | |
| TIMI flow 0 | 31 (10.33%) | 16 (14.95%) | 0.199 |
| TIMI flow 1 | 4 (1.33%) | 3 (2.80%) | 0.315 |
| TIMI flow 2 | 5 (1.67%) | 1 (0.93%) | 0.590 |
| TIMI flow 3 | 260 (86.67%) | 87 (81.31%) | 0.180 |
| *Post PCI TIMI flow grade, n (%):* | | | |
| TIMI flow 0 | 11 (3.67%) | 5 (4.67%) | 0.646 |
| TIMI flow 1 | 1 (0.33%) | 2 (1.87%) | 0.111 |
| TIMI flow 2 | 1 (0.33%) | 0 (0.00%) | 0.550 |
| TIMI flow 3 | 287 (95.67%) | 100 (93.46%) | 0.364 |
| *Residual stenosis, n (%):* | | | |
| Yes | 284 (94.67%) | 92 (85.99%) | |
| No | 16 (5.33%) | 15 (14.01%) | 0.004 |
| Pre PCI stenosis % (range, mean ± SD) | 70–100 (86.01 ± 9.25) | 70–100 (86.22 ± 10.48) | 0.843 |
| Post PCI residual stenosis % (range, mean ± SD) | 00–100 (6.91 ± 2.06) | 00–100 (14.35 ± 2.38) | 0.005 |
| Length of lesion (mm) (range, mean ± SD) | 5–55 (14.01 ± 4.51) | 5–50 (15.64 ± 7.40) | 0.062 |
| Balloon Diameter (mm) (range, mean ± SD) | 1.50–3.50 (2.25 ± 0.42) | 1.00–3.75 (2.19 ± 0.58) | 0.313 |
| Balloon Length (mm) (range, mean ± SD) | 6–21 (14.26 ± 3.01) | 6–20 (14.71 ± 3.83) | 0.248 |
| Bare metal stent diameter (mm) (range, mean ± SD) | 2.25–4.50 (2.99 ± 0.42) | 2.25–4.50 (3.02 ± 0.45) | 0.7 |
| Bare metal stent length (mm) (range, mean ± SD) | 8–28 (15.83 ± 4.54) | 8–28 (15.27 ± 4.90) | 0.399 |
| Drug eluting stent diameter (mm) (range, mean ± SD) | 2.25–3.50 (2.89 ± 0.34) | 2.25–3.50 (2.73 ± 0.32) | 0.15 |
| Drug eluting stent length (mm) (range, mean ± SD) | 12–33 (21.32 ± 4.94) | 12–33 (21.00 ± 6.29) | 0.857 |

PCI = Percutaneous coronary intervention; *n* = Number, pts = Patients; TIMI = Thrombolysis in myocardial infarction flow; pts = Patients; ACC/AHA = American college of cardiology/American heart association; Residual stenosis = < 20% in stented segments or < 50% in balloon angioplasty segments; mm = millimeter.

access, reflecting a degree of vein graft case selection. By summation of the complex end of the spectrum for ACC/AHA lesion types B2 plus C, the incidence was 241 lesions (80.33%) in r-PCI vs. 83 lesions (77.57%) in f-PCI, $P = 0.25$. These data illustrate that, complex lesion morphology was done routinely via the radial route without resorting to femoral access, as there is no cross over from radial to femoral due to inability to complete the procedure in our study. Also previous studies have suggested that the radial route is equivalent to the femoral route for complex PCI in general,[30] and for vein graft PCI in particular.[31]

However according to our institutional policy, bypass graft cases were selected for femoral access, which is clear from data presented in Tables 3 that selection has occurred. Reasons for selecting femoral access for cases with bypass grafts included the need to image or treat certain vein grafts (generally high origin left sided grafts), requirement of a larger guide catheter than the radial artery might accommodate (seven French or greater), inability to advance the guide catheter into the aortic root, other guide catheter handling or support issues despite successful engagement of the coronary ostium, and previous problematic, painful, or unsuccessful radial access, insufficient radial artery size or patency on palpation of the vessel, or the presence of a femoral arterial sheath in situ following diagnostic catheterization.[29] However, Roberts et al.[29] stated that, not all vein graft lesions would have actually required femoral access, the route having been chosen to facilitate management of a subset of vein grafts with high origin.

The present study suggests that there is no preference for femoral access in treatment of total occlusion, as the number of lesions with total occlusions in the radial group were 35 (11.66%), while in the femoral group, it was 19 lesions (17.75%), and angiographic success was achieved in 21 lesions

(60%) in radial PCI vs. 11 lesions (57.89%) in the femoral group, $P = 0.43$.

The angiographic success rate in our study was significantly higher in the radial group 94.33% vs. 85.99% in the femoral group ($P = 0.004$). This can be attributed due higher proportion of certain types of complex anatomy (lesion type C) in the femoral group. However, Roberts et al.[29] reported angiographic success rate of 96.5% in 2049 lesions subjected to radial PCI in his study. Also a notable finding in his study is that lesions treated via radial access were at the complex end of the spectrum of ACC/AHA lesion types, with an incidence of 4.6%, 15%, 40.7%, and 39.7% for lesions A, B1, B2, and C respectively.

The Society for Cardiac Angiography and Interventions (SCAI) risk score used an ordinal ranking of two composite criteria (vessel patency and complex morphology) to classify lesions into four groups: non-type C–patent, type C–patent, non-type C–occluded, and Type C–occluded.[32] We did not use the Society for Coronary Angiography and Interventions (SCAI) lesion classification system in our study, as it was validated from a voluntary registry, which imposes a potential bias because the operator classified the lesion after finishing the case and knowing whether the case was successful or had complications. No prospective studies using core laboratory analysis have validated this system. Nonetheless, the SCAI classification system utilizing vessel patency in addition to C and non-C class appears promising to categorize the risk of success and complications with PCI.[1] The predictive value of two other risk scores has been compared to the ACC/AHA lesion complexity score. The ACC/AHA classification had a correlation (C) - statistic of 0.69; the modified ACC/AHA system had a C-statistic of 0.71; and the SCAI classification had a C-statistic of 0.75.[33,34] The Mayo Clinic Risk Score added the integer scores for the presence of eight morphological variables and provided a better risk stratification than the ACC/AHA lesion classification for predicting cardiovascular complications, whereas the ACC/AHA lesion classification was a better system for identifying angiographic success.[35]

In conclusion, this study confirms that a default radial PCI is an effective strategy for the majority of cases and lesions in elective PCI. This study provides an insight into data regarding the relationship between the radial arterial access, target lesion and vessel complexity, and angiographic outcome, but we should keep in mind that this work was a nonrandomized data base study. Furthermore, these data represent default radial access operators in elective and emergency PCI, and similar results might not be achieved by operators less familiar with radial procedures.

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