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Original Article

Applicability of Distal Radial Artery Access in Acute Coronary Syndrome: A Single-Center Observational Registry Study

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Abstract

Background: Distal Radial Artery Access (DRA) has emerged as an alternative vascular access for Coronary Angiography (CGA) and Percutaneous Coronary Intervention (PCI). However, real-world data regarding its procedural feasibility and outcomes remain limited. This study aimed to evaluate the feasibility and procedural outcomes of distal radial artery access in patients undergoing CGA and/or PCI.

Methods: We conducted a single-center observational registry including consecutive patients undergoing CGA or PCI with an initial attempt at DRA access. The primary feasibility endpoint was successful completion of the procedure via DRA without crossover to an alternative vascular access site.

Results: A total of 835 patients were included in the analysis, representing an all-comer cohort including both Acute Coronary Syndrome (ACS) and Chronic Coronary Syndrome (CCS) presentations. The clinical indications included Non-ST-segment Elevation Myocardial Infarction (NSTEMI) in 326 patients (39%), Unstable Angina Pectoris (UAP) in 292 patients (35%), ST-segment Elevation Myocardial Infarction (STEMI) in 167 patients (20%), and stable coronary artery disease in 50 patients (6%). The primary feasibility endpoint, successful completion of the procedure via DRA without crossover, was achieved in 811 patients (97.1%). Crossover to an alternative access site occurred in 24 patients (2.9%), including contralateral proximal radial access in 13 patients (54.2%), femoral access in 10 patients (41.7%), and ipsilateral proximal radial access in 1 patient (4.2%).

Conclusions: DRA access demonstrated high procedural feasibility for CGA and PCI in a real-world cohort including both acute and CCS presentations.

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Introduction

Transradial Access (TRA) has become the preferred vascular access for Coronary Angiography (CGA) and Percutaneous Coronary Intervention (PCI) because it is associated with lower rates of bleeding complications, earlier patient mobilization, and improved patient comfort compared with transfemoral access.[1] Although both approaches demonstrate comparable procedural success rates, TRA has been associated with significant reductions in mortality and major cardiovascular events.[2] However, TRA also has several complications, including radial artery injury, Radial Artery Spasm (RAS), Radial Artery Occlusion (RAO), pseudoaneurysm, Arteriovenous (AV) fistula, and complex regional pain syndrome.[3]

In recent years, Distal Radial Access (DRA) has emerged as an alternative puncture site to the conventional Proximal Transradial Access (pTRA). Observational studies have demonstrated that DRA is feasible and safe, with several advantages, including lower rates of vascular complications and shorter hemostasis times.[4] The distal radial artery is accessed in the anatomical snuffbox or on the dorsum of the hand, distal to the conventional wrist access site used for pTRA.[5] Although the difference in puncture site location may appear minimal, DRA offers important anatomical and physiological advantages. This technique minimizes the risk of RAO, even if distal occlusion occurs, by preserving antegrade flow to the superficial palmar arch. Furthermore, this approach avoids direct injury to the pTRA, thereby preserving the vessel for future interventions or surgical use.[6-7]

Interest in DRA has recently expanded to patients with Acute Coronary Syndrome (ACS), in whom rapid vascular access and procedural efficiency are critical, particularly in time-sensitive settings such as ST-segment Elevation Myocardial Infarction (STEMI). The DRAMI trial has reported encouraging results regarding the feasibility of DRA in ACS settings.[8] In Indonesia, a recent study conducted at Dr. Hasan Sadikin General Hospital compared long-term RAO after DRA with that after pTRA during invasive procedures, which showed a favorable local DRA experience in angiography with 92.4% successful sheath insertion.[9] However, data remain relatively limited compared with the extensive evidence for conventional radial access.

Therefore, this study aimed to evaluate the feasibility and safety of DRA in patients undergoing CAG and/or PCI in routine clinical practice. This registry included consecutive patients who underwent an initial DRA attempt, regardless of clinical indication, allowing assessment of DRA performance in an all-comers population while also reflecting its use in contemporary ACS care.

Methods

Study Design

This study was a single-center observational registry evaluating the feasibility and safety of DRA for CAG and/or PCI. The study was conducted at Umar Wirahadikusumah General Hospital, Sumedang, West Java, Indonesia, between June 2020 and April 2024.

Study Population

The study population included all consecutive adult patients (≥18 years) who underwent CAG and/or PCI in whom DRA was initially attempted and who were enrolled in the registry during the study period. Patients were included regardless of clinical presentation or indication for CAG and/or PCI. Patients who required crossover to another vascular access site following a failed DRA puncture were also included in the analysis. All included patients were informed of the procedure and their inclusion in the registry before participation. Informed consent was obtained from all individual participants included in the study.

Procedural Techniques

DRA access was obtained at the anatomical snuffbox or distal dorsoradial segment of the radial artery using standard puncture techniques, according to operator preference. The procedure was performed predominantly via the left distal radial artery. Vascular access was achieved using a palpation-guided technique without ultrasound assistance. A 6-Fr introducer with a standard sheath was used to facilitate catheter manipulation. Following successful sheath insertion, an intra-arterial antispasmodic consisting of heparin (3000-5000 IU), nitroglycerin (100-200 μg), and/or verapamil (2.5-5 mg) was administered according to the institutional protocol to prevent RAS. Anticoagulation was also given in accordance with the institutional standard protocol, with dosing adjustments. At the end of the procedure, hemostasis was achieved using a compression device (TR Band). Hemostasis management followed the institutional protocol. Procedures were performed by experienced interventional cardiologists familiar with transradial techniques.

Data Collection and Outcomes

Procedural and clinical data were prospectively recorded in the registry, including patients' demographics, procedural characteristics, puncture success, access-site crossover, and access-related complications. Anthropometric variables such as Body Mass Index (BMI) were only available for a subset of patients due to incomplete documentation in the medical records during the early phase of the registry.

The primary feasibility endpoint was defined as successful completion of the procedure via DRA without crossover to another vascular access site.[10-11] A failed puncture was defined as the inability to cannulate the DRA after multiple attempts. Crossover was defined as the need to switch to an alternative access site after an initial attempt at DRA. It was categorized as ipsilateral proximal radial access, contralateral radial access, or femoral access.

Safety was defined as the absence of access-site-related complications, including hematoma at the puncture site, RAS, RAO, AV fistula formation, pseudoaneurysm, bleeding requiring intervention, nerve injury, and other vascular complications. Complications were classified as major and minor based on clinical severity and the requirement for additional therapeutic intervention. Assessment of RAO or distal RAO was based on clinical examination during hospitalization and routine clinical follow-up.

Statistical Analysis

Statistical analysis was performed using descriptive statistics. Continuous variables are presented as mean ± standard deviation. Categorical variables are reported as frequencies and percentages. No comparative or inferential statistical analysis was performed. All data were analyzed using PSA and reviewed by the co-authors. Although the registry spans several years, procedural data were not systematically recorded in a manner allowing formal temporal learning-curve analysis.

Ethics Approval

The study protocol was reviewed and approved by the Institutional Review Board, and the registry was conducted in accordance with the principles of the Declaration of Helsinki.

Results

Study Population and Indications for Procedure

Between June 2020 and April 2024, 835 patients undergoing CAG and/or PCI with an initial DRA attempt were enrolled in the registry. The study cohort included patients with a broad range of clinical indications, including both ACS and non-ACS presentations. The mean age of the study population was 59.8 years, with the majority of patients being male (635 patients, 76%). Baseline demographic and anthropometric characteristics are summarized in Table 1.

The study cohort included patients with both ACS and Chronic Coronary Syndrome (CCS). The study flow diagram illustrating patient inclusion and procedural outcomes is presented in Fig. 1. The distribution of clinical indications for CGA and/or PCI is shown in Fig 2. Non-ST-segment Elevation Myocardial Infarction (NSTEMI) was the most frequent presentation, occurring in 326 patients (39%), followed by Unstable Angina Pectoris (UAP) in 292 patients (35%), STEMI in 167 patients (20%), and stable coronary artery disease in 50 patients (6%). Overall, patients presenting with ACS accounted for 785 of 835 patients (94%) in the study population. Among patients who underwent PCI, the Left Anterior Descending artery (LAD) was the most commonly treated vessel, accounting for 47.8% of cases (Fig. 3).

Table 1. Baseline characteristics of the participants.

Parameter	n (%)
Demographics	
Age (years)	59.8
Female, n (%)	200 (24%)
Male, n (%)	635 (76%)
Anthropometrics	
Weight (kg) (n=460)	62.6
Height (cm) (n=460)	157.57
BMI (kg/m^2) (n=460)	24.76

BMI: Body Mass Index.

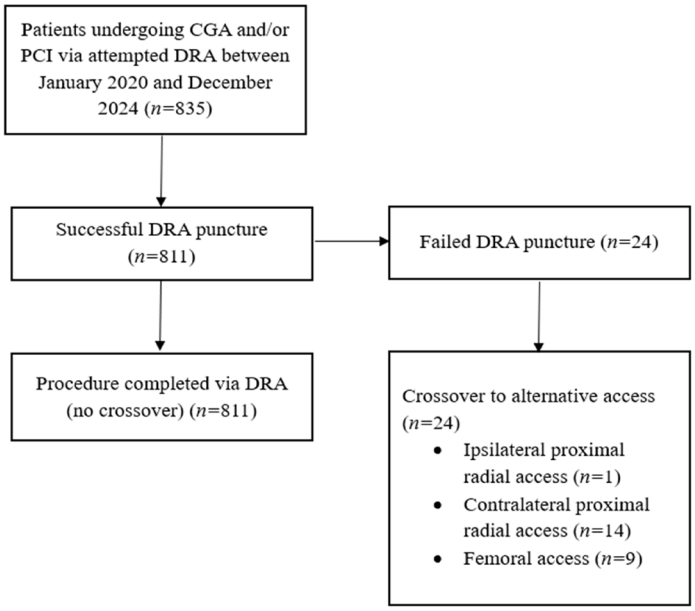


Figure 1. Study flow diagram.

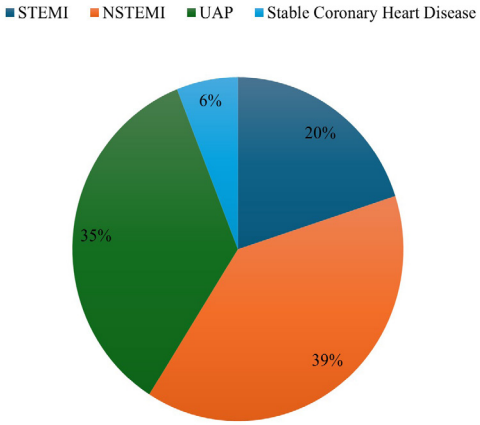


Figure 2. Indication for angiography.

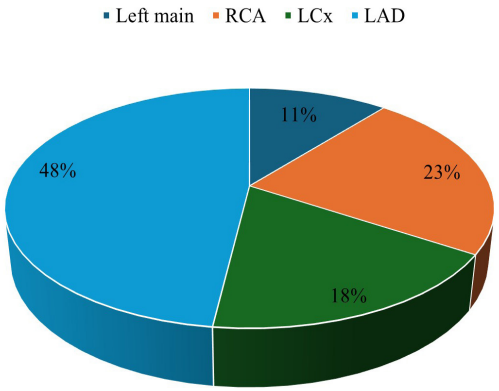


Figure 3. Coronary artery treated with distal radial access (DRA).

Feasibility of DRA

The predefined primary feasibility endpoint, defined as successful completion of the procedure via DRA without crossover, was achieved in 811 of 835 patients, yielding a puncture success rate of 97.1% (Fig. 4). Left DRA was performed in 742 patients (91.5%). In comparison, right DRA was performed in 69 patients (8.5%). Diagnostic CGA was completed in all patients with successful DRA (100%).

In comparison, a failed puncture occurred in 24 patients (2.9%), necessitating crossover to an alternative vascular access site. A failed puncture was defined as the inability to cannulate the DRA after multiple attempts, necessitating crossover to an alternative vascular site. In these cases, crossover to another vascular access site was performed. The distribution of crossover routes was as follows: ipsilateral proximal radial access, 1 patient (4.1%), contralateral proximal radial access, 14 patients (58.3%), and femoral access, 9 patients (37.6%). Percentages for crossover routes were calculated using the crossover subgroup (n=24) as the denominator. Detailed information regarding puncture success, crossover patterns, and procedural outcomes is summarized in Table 2.

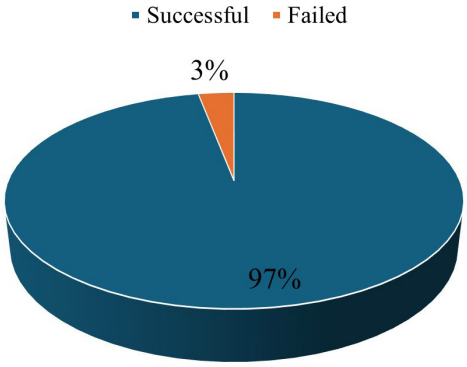


Figure 4. Success rate of distal radial access (DRA).

Table 2. Participants' puncture rate, crossover site, and complication.

Variable	n (%)
Patients who tried the distal radial approach (DRA)	835
Success rate of DRA puncture	811 (97.1%)
Left Distal Radial	742 (91.5%)
Right Distal Radial	69 (8.5%)
Patients with failed DRA puncture	25 (3.0%)
Crossover to the conventional radial approach	
Ipsilateral	1 (4.1%)
Contralateral	14 (58.3%)
Crossover to the femoral approach	9 (37.6%)
Patients with successful DRA puncture	
Success rate of diagnostic CAG	811 (100%)
Complication at DRA	3 (0.5%)
Hematoma	2 (0.35%)
AV fistula formation	1 (0.17%)

Values are presented as n (%). Percentages referring to the overall cohort use N = 835 as the denominator unless otherwise specified. Percentages describing crossover routes use the crossover subgroup (n = 24) as the denominator. The primary feasibility endpoint was defined as successful completion of the procedure via distal radial artery access without crossover to another vascular access site. DRA: Distal Radial Approach; CAG: Coronary Angiography; AV: Arteriovenous.

Safety and Access-Site Complications

Access-site safety outcomes were assessed in all enrolled patients. Overall, access-site-related complications were observed in 3 of 835 patients (0.5%). Minor complications included hematoma at the puncture site in 2 patients (0.35%). One patient (0.17%) developed an AV fistula during follow-up. No major access-site-related complications were observed, including severe bleeding requiring intervention, pseudoaneurysm formation, nerve injury, or symptomatic RAO. RAO or distal artery occlusion was assessed based on clinical examination during hospitalization and routine follow-up. Because Doppler ultrasound was not routinely performed, subclinical RAO may have been under-detected. This limitation should be considered when interpreting the reported safety outcomes. A summary of access-site complications is presented in Table 2.

Discussion

In this single-center registry, DRA demonstrated a high rate of procedural completion without crossover, with the predefined feasibility endpoint achieved in 97.1% of cases. These findings suggest that DRA can be successfully implemented in routine clinical practice for CGA and/or PCI, including patients presenting with ACS.

Our study population, with a mean age of 59.8 years and a predominance of male patients, is consistent with prior studies of patients undergoing coronary interventions. NSTEMI was the most common indication for angiography, highlighting clinical practice in which NSTEMI accounts for a substantial proportion of patients requiring early invasive evaluation to guide appropriate treatment strategies. Among patients undergoing PCI, the LAD was the most frequently treated vessel. This observation is consistent with the clinical understanding that the LAD is a common culprit artery in coronary artery disease.

The procedural success rate (97.1%) observed in our cohort is also consistent with previously reported DRA registries and randomized studies. Similar feasibility has been reported in the DRAMI trial, which evaluated DRA in STEMI patients undergoing primary PCI.[8,12] These findings support the feasibility of DRA in routine clinical practice. Operator experience and procedural standardization may have contributed to the observed high success rate, as all procedures were performed by interventional cardiologists experienced with transradial techniques.

The crossover rate in our cohort was low (2.9%), despite the known anatomical characteristics associated with the distal radial artery, including smaller vessels and increased tortuosity compared to the proximal artery.[13] Most procedures were completed using a 6-Fr sheath, suggesting DRA can support both diagnostic angiography and coronary interventions.[6] When crossover was required, it was likely related to anatomical variations, arterial spasms, or technical difficulties during sheath advancement, as described in previous studies.[6,14]

Access-site complications were infrequent in our cohort, comprising a minor hematoma and a single case of AV fistula formation. No major access-site complications were reported. However, systematic Doppler ultrasound screening for RAO was not routinely performed in this registry. Consequently, the incidence of asymptomatic RAO or distal artery occlusion may have been underestimated. Therefore, our findings should be interpreted as reflecting clinically recognized complications, rather than the true incidence of vascular injury associated with DRA. On the other hand, these findings are also consistent with prior reports demonstrating a favorable safety profile for DRA.[15] Minor hematomas, when present, may be influenced by factors such as antithrombotic therapy, repeated puncture attempts, or compression techniques. At the same time, AV fistula remains a rare complication that is often manageable with conservative treatments.[16-19]

Our study supports the procedural feasibility of DRA and suggests a low rate of clinically recognized access-site complications in this real-world cohort. Although large multicenter registries have established the feasibility and safety of DRA across diverse practice settings, our findings, based on observational data, show similar procedural outcomes in a single-center real-world cohort of ACS patients. A single-center design allowed consistency and standardized access techniques, reducing variability related to operator preferences and access strategies.

Conclusion

DRA access demonstrated high procedural feasibility in this single-center registry of patients undergoing CGA and PCI, including both ACS and non-ACS indications. The procedure was completed via DRA in the majority of cases, with a low rate of clinically apparent access-site complications observed during the index procedure.

However, these findings should be interpreted with caution because standardized surveillance for RAO or distal RAO, such as routine Doppler ultrasound follow-up, was not systematically performed, and subclinical events may therefore be under-detected.

Future studies incorporating standardized radial artery patency assessment and multicenter or comparative designs, particularly in ACS populations, are warranted to clarify further the safety profile and clinical role of DRA in contemporary coronary procedures.

List of Abbreviations

ACS	Acute Coronary Syndrome
AV	Arteriovenous
BMI	Body Mass Index
CCS	Chronic Coronary Syndrome
CGA	Coronary Angiography
DRA	Distal Radial Access
LAD	Left Anterior Descending
NSTEMI	Non-ST-segment Elevation Myocardial Infarction
PCI	Percutaneous Coronary Intervention
pTRA	Proximal Transradial Access
RAO	Radial Artery Occlusion
RAS	Radial Artery Spasm
STEMI	ST-segment Elevation Myocardial Infarction
TRA	Transradial Access
UAP	Unstable Angina Pectoris

Ethical Clearance

Ethical approval was obtained from the Institutional Review Board, and the registry was conducted in accordance with the principles of the Declaration of Helsinki.

Publication Approval

All authors consent to the publication of this manuscript.

Authors' Contributions

PSA: Conceptualization, methodology, data curation, formal analysis, investigation, interpretation of data, and project administration; drafting and revising the manuscript; CP: Writing—original draft, writing—review and editing, and manuscript preparation; AUD: Supervision and critical review of the manuscript; RHW: Supervision, methodology oversight, interpretation of findings, and critical revision of the manuscript. All authors reviewed and approved the final version of the manuscript and agreed to be accountable for all aspects of the work.

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Conflict of Interest

None.

Availability of Data and Materials

Not applicable.

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Copyright/Permissions for Figures

Not applicable.

Generative AI and AI-Assisted Technologies in the Writing Process

Authors acknowledge that artificial intelligence (AI) tools were only used to assist in language editing and did not generate or alter the scientific content, analyses, or conclusions presented in this manuscript.

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