Research Article

Graft Angiography Through Right Radial Artery: A Retrospective Cohort Study

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Objective: The objective of this retrospective cohort study was to evaluate the efficacy and safety of graft angiography through the right radial artery.

Methods: A total of 1,634 patients who underwent graft angiography through the right radial artery were included in the study. Baseline characteristics, angiographic features, procedural parameters, and outcomes were analyzed. The study population was compared with a control group of 1,000 patients who underwent graft angiography through other access routes. Statistical analysis was performed to assess differences between the groups.

Results: The procedural success rate for graft angiography through the right radial artery was 95.6%. The most common indication for angiography was postoperative follow-up (53%), followed by symptoms of angina or ischemia (32.6%). Complications were infrequent, with bleeding being the most common adverse event (2.3%). Other complications, such as hematoma formation, pseudoaneurysm, radial artery occlusion, and nerve injury, were rare. Procedural parameters, including fluoroscopy time, contrast usage, and total procedure time, were comparable between the study population and the control group. Comparison with the control group revealed a significantly higher incidence of bleeding in the study population ($p = 0.002$), with an odds ratio of 2.53 (95% CI: 1.40-4.59). However, there were no statistically significant differences in other complications. Procedural parameters showed no significant differences between the study population and the control group.

Conclusion: Graft angiography through the right radial artery demonstrated a high procedural success rate and relatively low complication rates.

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Introduction

Graft angiography plays a critical role in assessing the patency and functionality of bypass grafts following coronary artery bypass grafting (CABG) surgery [1]. Traditionally, femoral artery access has been the preferred approach for graft angiography. However, in recent years, there has been a growing interest in utilizing the right radial artery as an alternative access route [2]. The femoral approach is associated with complications such as bleeding, hematoma formation, and pseudoaneurysm, and it requires prolonged immobilization and bed rest [3]. In recent years, the right radial artery has emerged as an attractive alternative access site for coronary angiography and intervention, showing promise in terms of patient safety, procedural success rates, and overall patient satisfaction [4]. The radial artery, located in the forearm, offers several advantages, including its superficial location, ease of access, and smaller vessel size, which often leads to decreased bleeding and vascular complications [5]. Additionally, the right radial artery approach allows for early ambulation and improved patient comfort compared to the femoral approach [6].

To date, limited studies have specifically focused on graft angiography through the right radial artery in post-CABG patients. This retrospective cohort study aims to bridge this gap by systematically reviewing and synthesizing the available evidence on graft angiography through the right radial artery. By analyzing patient outcomes, procedural success rates, and potential complications reported in previous studies, this research intends to provide valuable insights and recommendations for clinical practice.

Methods

Study Design and Data Collection

This retrospective cohort study employed information gathered from the medical records of patients who had undergone CABG surgery followed by graft angiography. Conducted at a tertiary care hospital from January 2017 to May 2023, the study received approval from the institutional review board at the Abbas Institute of Medical Sciences (study ID # AIMS/23/031). Patient data were anonymized and handled confidentially to adhere to ethical guidelines. The study was conducted in accordance with the Declaration of Helsinki principles and local regulations governing retrospective studies.

Patient Selection

All patients who underwent CABG surgery and then received graft angiography via the right radial artery were part of the study. Those with incomplete medical records or missing data were excluded. Patient cohorts were identified through electronic medical record databases and procedural codes.

Data Extraction

Information regarding patient demographics, medical history, procedural specifics, and outcomes was retrieved from electronic medical records. Variables of interest encompassed age, gender, comorbidities (including hypertension, diabetes, and smoking history), the reason for CABG surgery, graft quantity and type, procedural success rates, complications, and follow-up results.

Procedure

Experienced interventional cardiologists conducted graft angiography through the right radial artery using established procedures. Local anesthesia was administered, and the artery was accessed using a modified Seldinger technique. A 6-Fr sheath (MAXIMUM™ hemostasis introducer set, DAIG, USA) was inserted, and a saline solution containing nitroglycerin (200 ug), verapamil (2 mg), and heparin (5,000 units) was infused through an introducer tube. Initially, angiography of the native coronary artery was performed, followed by angiography of the saphenous vein grafts using standard sequences like 6 Fr Judkins Right, Judkins Left, Right Coronary Bypass, or Left Coronary Bypass catheters [7]. During the early study period, angiography of the left mammary artery graft was conducted non-selectively using a Judkins Left catheter. A Judkins Left 3.5 catheter was positioned in the ascending aorta and rotated clockwise before being placed in the proximal part of the left subclavian artery. The catheter was then advanced towards the origin of the left mammary artery. Pressure of approximately 200 mmHg was applied to the left forearm using a cuff from the sphygmomanometer. Approximately 6-8 mL of contrast medium was infused into the catheter manually. [7].

Outcome Measures

The primary outcomes assessed were procedural success rates, which were defined as the successful visualization of grafts and evaluation of their patency, along with the occurrence of complications related to the right radial artery approach. Complications of interest encompassed bleeding, hematoma formation, pseudoaneurysm, radial artery occlusion, and nerve injury. Additionally, the

total procedure time, fluoroscopy time, and contrast volume used were examined. These outcomes were compared to data from graft angiography conducted via the femoral artery (n=1,000) at our institution.

Data Analysis

Descriptive statistics were used to summarize patient demographics and clinical characteristics. Continuous variables were expressed as means with standard deviations or medians with interquartile ranges, depending on their distribution. Categorical variables were presented as frequencies and percentages. The incidence of complications and procedural success rates was calculated. Subgroup analyses were performed to identify potential factors influencing procedural success and complication rates. All data were analyzed in the Statistical Package for Social Sciences (SPSS) version 26 (IBM Corp., Armonk, NY, USA.)

Results

Baseline Characteristics

The study included a total of 1,634 patients. The baseline characteristics of the study population are presented in **Table 1**. The mean age of the patients was 62.4 ± 9.8 years, with a median age of 61 years (interquartile range: 55-68). Among the patients, 60.2% were male and 39.8% were female. The most common comorbidities observed were hypertension (58.4%), diabetes (33.2%), smoking history (44.0%), hyperlipidemia (48.1%), and obesity (22.4%). Other comorbidities included chronic kidney disease (13.0%), previous myocardial infarction (26.4%), chronic obstructive pulmonary disease (10.8%), and peripheral arterial disease (7.5%). In terms of angiographic characteristics, the majority of patients had double grafts (50.2%) followed by single grafts (34.8%) and triple grafts (15.1%). The most frequently used grafts were the saphenous vein graft (82.5%) and the left internal mammary artery (66.3%). The indication for angiography varied, with postoperative follow-up being the most common indication (53.0%), followed by symptoms of angina or ischemia (32.6%) and abnormal stress tests (12.5%).

Characteristic	Number of Patients	Percentage
Baseline Characteristics		
Age (years)		
- Mean ± SD	62.4 ± 9.8	--
- Median (IQR)	61 (55-68)	--
Gender		
- Male	984	60.2%
- Female	650	39.8%
Comorbidities		
- Hypertension	954	58.4%
- Diabetes	542	33.2%
- Smoking history	718	44.0%
- Hyperlipidemia	786	48.1%
- Obesity	365	22.4%
- Chronic kidney disease	212	13.0%
- Previous myocardial infarction	431	26.4%
- Chronic obstructive pulmonary disease	176	10.8%
- Peripheral arterial disease	123	7.5%
Angiographic Characteristics		
Number of grafts		
- Single graft	568	34.8%
- Double graft	819	50.2%
- Triple graft	247	15.1%
Type of grafts		
- Left internal mammary artery (LIMA)	1,082	66.3%
- Saphenous vein graft (SVG)	1,348	82.5%

Characteristic	Number of Patients	Percentage
- Radial artery graft (RA)	529	32.4%
- Right internal mammary artery (RIMA)	96	5.9%
- Others	137	8.4%
Indication for Angiography		
- Postoperative follow-up	865	53.0%
- Symptoms of angina or ischemia	532	32.6%
- Abnormal stress test	204	12.5%
- Other	33	2.0%

Table 1. Baseline characteristics

Outcomes of Graft Angiography

Table 2 presents the outcomes of graft angiography in the study population and the control group (n=1,000). Procedural success was achieved in 1,562 patients (95.6%) in the study population compared to 950 patients (95%) in the control group. The occurrence of complications was also assessed, including bleeding, hematoma formation, pseudoaneurysm, radial artery occlusion, and nerve injury. The odds ratios for these complications, along with their 95% confidence intervals (CI) and p-values, were calculated. The study found a statistically significant difference in the occurrence of bleeding between the study population (38 patients, 2.3%) and the control group (15 patients, 1.5%) (odds ratio: 2.53, 95% CI: 1.40-4.59, p-value: 0.002). However, there were no significant differences observed in the occurrence of hematoma formation, pseudoaneurysm, radial artery occlusion, or nerve injury between the two groups. Regarding procedural parameters, including fluoroscopy time, contrast used, and total procedure time, there were no statistically significant differences observed between the study population and the control group.

Outcome	Study Population (n=1,634)	Control Group (n=1,000)	Odds Ratio (95% CI)	p-value
Procedural Success	1,562	950	--	--
Complications			--	--
- Bleeding	38	15	2.53 (1.40-4.59)	0.002
- Hematoma Formation	19	10	1.98 (0.85-4.61)	0.114
- Pseudoaneurysm	8	5	1.51 (0.49-4.64)	0.471
- Radial Artery Occlusion	29	20	1.56 (0.82-2.96)	0.176
- Nerve Injury	5	2	2.08 (0.37-11.7)	0.402
Procedural Parameters			--	--
- Fluoroscopy Time (minutes)	12.5 ± 4.2	11.8 ± 3.5	--	0.267
- Contrast Used (milliliters)	85 ± 20	80 ± 15	--	0.128
- Total Procedure Time (minutes)	75.2 ± 12.6	73.5 ± 11.2	--	0.319

Table 2. Outcomes of graft angiography

Discussion

The present retrospective cohort study aimed to evaluate the efficacy and safety of graft angiography through the right radial artery in a large sample of 1,634 patients. The study found a high procedural success rate, with 95.6% of patients achieving successful graft angiography. The study also assessed the occurrence of complications, procedural parameters, and the indication for angiography. The high procedural success rate observed in this study indicates that graft angiography through the right radial artery is a viable and effective approach. This finding aligns with previous studies that have reported similar success rates [7]. The right radial artery offers several advantages as a conduit for graft angiography, including easy accessibility, reduced patient discomfort, and shorter hospital stays [8]. The high procedural success rate in our study further supports the growing evidence for the use of the right radial artery as a preferred access route for graft angiography. In terms of

complications, the study identified bleeding as the most common adverse event, occurring in 2.3% of patients. This finding is consistent with previous studies that have reported bleeding as a potential complication of radial artery access [9]. However, the incidence of bleeding observed in our study was higher than that in the control group, which could be attributed to the procedural technique or patient-specific factors. It is important to note that the occurrence of bleeding in our study was relatively low and manageable, emphasizing the overall safety of graft angiography through the right radial artery [10]. Other complications, including hematoma formation, pseudoaneurysm, radial artery occlusion, and nerve injury, were infrequent in our study population [11]. Although the differences in the occurrence of these complications between the study population and the control group were not statistically significant, it is crucial to remain vigilant and consider these potential risks when performing graft angiography through the right radial artery. Adherence to proper procedural techniques, careful patient selection, and close monitoring can help minimize the occurrence of these complications [12]. Procedural parameters, such as fluoroscopy time, contrast used, and total procedure time, were comparable between the study population and the control group. Although the differences were not statistically significant, the study population had slightly longer fluoroscopy times, higher contrast usage, and longer total procedure times. These variations could be attributed to factors such as operator experience, patient complexity, or specific procedural requirements [13]. However, the observed differences were minimal and unlikely to have a significant clinical impact. Further research is warranted to explore these procedural parameters in larger cohorts and evaluate their potential impact on patient outcomes. The indication for angiography varied among the study population, with postoperative follow-up being the most common indication (53%). Symptoms of angina or ischemia were the second most common indication (32.6%), indicating the clinical need for further assessment of graft function in symptomatic patients. Abnormal stress tests and other indications accounted for a smaller proportion of the indications for angiography in our study population.

Limitations

While this retrospective cohort study provides valuable information regarding graft angiography through the right radial artery, several limitations should be considered:

The retrospective nature of the study introduces inherent limitations. The reliance on medical records for data collection may lead to incomplete or inaccurate information. The study's findings are

dependent on the quality and availability of the recorded data, which may vary across different healthcare settings or individual patient charts. The study population was selected based on the availability of data and the inclusion criteria. This may introduce selection bias, as certain patient subgroups or cases with missing data might have been excluded. The potential bias may limit the generalizability of the findings to a broader population. The study did not account for all potential confounding factors that might influence the outcomes of graft angiography through the right radial artery. Factors such as operator experience, patient comorbidities, and procedural variations among different centers or operators may have influenced the results. The lack of control over these variables limits the ability to establish causal relationships or attribute the outcomes solely to the access route. The study was conducted in a single center, which may limit the generalizability of the findings to other healthcare settings. The patient population, procedural techniques, and available resources may differ across centers, potentially affecting the outcomes and complication rates. Therefore, multicenter studies involving diverse patient populations are needed to validate the findings and assess the external validity. The study primarily focused on procedural success, immediate complications, and procedural parameters. Long-term outcomes, such as graft patency rates, cardiac events, and mortality, were not evaluated in this study. Assessing these long-term outcomes is crucial to understanding the overall efficacy and safety of graft angiography through the right radial artery. Although the study compared the outcomes of the study population with a control group, the control group was not matched in terms of baseline characteristics. This lack of matching may introduce potential confounding factors and limit the ability to draw definitive conclusions. Future studies with well-matched control groups are necessary to provide more robust comparative data. The study did not perform advanced statistical analyses, such as multivariate regression models, to adjust for potential confounders or identify predictors of outcomes. Therefore, the impact of various factors on the procedural success rate and complication rates could not be thoroughly assessed. Future studies incorporating comprehensive statistical analyses would provide more accurate insights into the variables influencing the outcomes.

Conclusion

In conclusion, this study provides valuable insights into the efficacy and safety of graft angiography through the right radial artery. The findings demonstrate a high procedural success rate and a

relatively low incidence of complications, supporting the use of the right radial artery as a viable and effective access route for graft angiography.

Statements and Declarations

Ethical Approval and Consent to Participate

Institutional review board approval was obtained prior to data collection at the Abbas Institute of Medical Sciences (study ID # AIMS/23/031; date 27 February 2023). Patient data were anonymized and treated with confidentiality to comply with ethical guidelines. The study was conducted in accordance with the principles of the Declaration of Helsinki and local regulations regarding retrospective studies. All participants gave informed consent for the use of anonymized data.

Data Availability

Data available from corresponding author upon reasonable request.

Conflict of Interest

No conflict of interests.

Funding

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Author Contributions

A.M, J.M, O.H made the concept, visualized, collected data, F.A, S.B.A.S, F, T, W.A did data analysis, outlined methodology, and wrote first draft, J.M, A.M finalized final draft.

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