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Original Article

Comparison of Radiation Dose and Contrast Dye Volume Comparison in Coronary Angiography Via Femoral and Radial Routes

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ABSTRACT

Coronary angiography is a common procedure used to identify coronary artery disease. Whether femoral or radial vascular access is employed may impact radiation dosage and contrast dye utilization. This study examined radiation exposure and contrast dye volume in femoral and radial approach in patients undergoing coronary angiography. **Objective:** To assess and compare the radiation dosage and contrast dye volume between patients having coronary angiography through the femoral and radial routes. **Methods:** A prospective study included 408 consecutive coronary angiography patients from April 10 to August 31, 2023. The remaining 206 patients were treated radially, while 202 were treated femorally. We examined radiation exposure, dose area product (DAP), and contrast dye volume among groups. **Results:** Radial and femoral groups had similar mean ages (64.4±12.1 vs. 64.8±11.6, p=0.86). The radial group had 60.67% men versus 71.3% in femoral group. Radial and femoral catheterization radiation doses were 1.199 Gy (0.677-2.001) and 1.218 Gy (0.696-2.207), respectively, with a *p*-value of 0.88 showing no group radiation exposure difference. The group analysis found no hemorrhagic consequences from radial or femoral catheterization, coronarography, or angioplasty. **Conclusions:** The study participants noticed non-significant differences in contrast dye volume and radiation dose between femoral and radial coronary angiography.

INTRODUCTION

When a patient is suspected of having coronary artery disease (CAD), coronary angiography is a crucial diagnostic procedure that is utilized to examine the coronary arteries [1]. This factor plays a crucial role in guiding treatment choices and procedures for individuals who show signs of (CAD) or have been thus diagnosed. Through the effective capture of X-ray pictures during the operation, which entails injecting a contrast agent into the coronary arteries, cardiologists were able to see any clogs or vessel irregularities [2, 3]. The femoral artery has traditionally served as the primary conduit for coronary angiography, owing to its comparatively greater diameter and convenient accessibility [4]. On the other hand, the radial artery has gained popularity lately as an alternative access route, with potential advantages including less bleeding problems, speedier patient mobilization, and improved patient comfort [5, 6]. An essential component of coronary angiography is the exposure to ionizing radiation. X-ray imaging exposes both patients and medical personnel to radiation, which might potentially cause health issues [7]. Additionally, providing contrast dye has drawbacks because sensitive individuals, especially those who already have renal impairment, may develop contrast-induced nephropathy [8, 9]. For patient safety and diagnostic improvement, comparing contrast dye volume and radiation dose for different coronary angiography access

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techniques is essential. In this research, individuals undergoing femoral and radial coronary angiography had their contrast dye volume and radiation dose compared. By comparing the contrast dye volume and radiation dose use differences in these two methods, healthcare professionals may choose the optimum access strategy for certain patients. The results of this research may lead to better patient outcomes, fewer negative effects, and more efficient coronary angiography resource usage. To assess and compare the radiation dosage and contrast dye volume between patients having coronary angiography through the femoral and radial routes.

METHODS

A descriptive comparative study was carried out that included 408 consecutive coronary angiography patients from April 10 to August 31, 2023 at Department of Cardiology, PIMS, Islamabad. Divided into two groups 206 patients were treated through the radial route, while 202 were treated via the femoral route. We examined radiation exposure, dose area product (DAP), and contrast dye volume among groups. This study sample size was set using power analysis to maximize statistical power (80.0%) alpha (0.05), anticipated volume of dye in radial approach (74.63±25.4) and (67.52±22.5) in femoral approach, leading to minimum sample size of 358 [10]. However finally 408 patients were enrolled during the study period. Patients were enrolled using non-probability convenient sampling technique. Exclusion criteria were used for internal validity and confounding variable control. To prevent delivery issues, this trial excluded iodinated contrast dye-sensitive patients. Due of radiation risks, pregnant women were excluded. Anomalies in creatinine or eGFR eliminated renal impairment. As contrast dye infusion could exacerbate renal failure. Patients with radial artery abnormalities or diseases that could impede radial approach were excluded. Acute coronary syndrome patients who required immediate procedures were removed for femoral or radial access. Exclusion criteria ensured that the study group was consistent and that the results were linked to the access technique (femoral or radial) without confounding factors. The participants who had coronary angiography throughout the designated study period had their medical records and angiography reports analyzed by the researchers. The procedure's pertinent information, such as the access method (femoral or radial), radiation dose measures (AK and DAP), and the amount of contrast dye, were extracted. The acquired data was then put together and entered into a SPSS version 23.0 for analyzing data. To summarize patient characteristics, operation information, radiation dose, and contrast dye volume measurements. The study protocol was submitted to the College of Physicians and Surgeons (CPSP) ethics committee to ensure patient rights were protected and ethical standards were followed. Before data collection began, ethical permission was acquired, and patient information was hidden to ensure anonymity. Objective of the statistical analysis was comparing radiation dosage and contrast dye volume in the femoral and radial groups. The mean dose area product for radiation dosage and the mean contrast dye volume for contrast delivery were the major results of interest. For continuous variables, use the independent t-test or Mann-Whitney U test. (e.g., radiation dose and contrast dye volume) and the chi-square test for categorical variables (e.g., procedural success rates and complication rates) were used to compare the two groups. A statistically significant p-value of less than 0.05 was evaluated. Additional subgroup studies based on patient demographics, clinical features, or procedural variables may be done if relevant to investigate possible factors impacting the radiation dosage and contrast dye volume. The statistical analysis findings were provided in tables and figures, together with relevant measures of central tendency and dispersion. The results were analyzed and discussed in light of the study's aims and previously published material.

RESULTS

Four hundred eight patients in all, separated into two groups, participated in this research. 206 instances (50.49%) were radial, and 202 (49.50%) were femoral. The mean ages of the radial and femoral groups were comparable (64.4±12.1 vs. 64.81±1.6, p=0.86). Femoral group, and radial group included 60.67% males and 39.32% females(Figure 1)p=0.07.

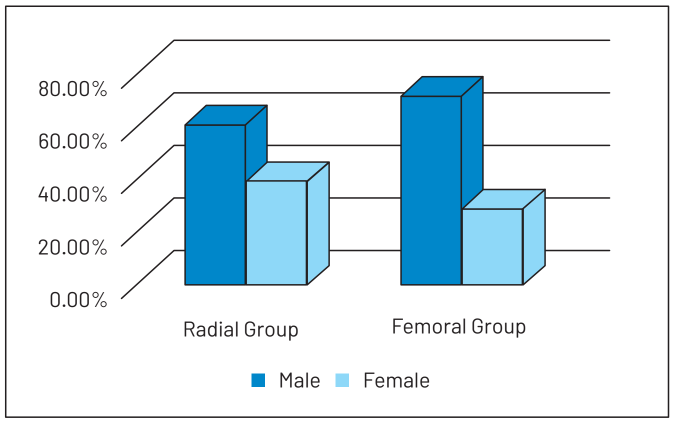

Figure 1: Gender Distribution

Diabetes, hyperlipidemia, and radial and femoral hypertension were comparable (p>0.05). Myocardial infarction, CABG, and aortic valve disease in both groups (p>0.05)(Figure 2).

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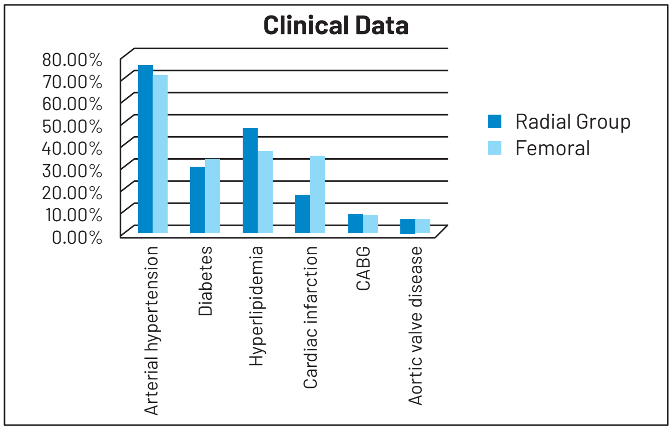

Figure 2: Clinical Data both Groups.

ST-elevation myocardial infarction (STEMI), non-STEMI, and unstable angina (UA) rates were comparable in both regions (*p* = 0.28). The rates of femoral and radial coronary angiography alone were comparable (60.19% vs. 59.90%, *p*=0.61). Both groups had PCI and coronary angiography (35.72% vs. 40.09%). Patients who had femoral and radial coronary angiography shared the same demographics, loads, indications, and procedures (Table 1).

Table 1: Basic clinical and demographic data of patients. (n=408)

Demographic data	Radial Group	Femoral Group	p-value
Number of Patients	206(50.49%)	202(49.50%)	0.86
Mean Age	64.4±12.1	64.8±11.6	
Gender			
Male	125(60.67%)	144(71.28%)	0.07
Female	81(39.32%)	58(28.71%)	
Patients' burdens			
Arterial hypertension	152(73.78%)	140 (69.30%)	0.50
Diabetes	58(28.15%)	65 (32.17%)	0.56
Hyperlipidemia	94(45.63%)	71 (35.14%)	0.14
Cardiac infarction	32 (15.53%)	67 (33.16%)	0.20
CABG	14(6.79%)	13 (6.43%)	0.91
Aortic valve disease	10(4.85%)	9 (4.45%)	0.84
Indications			
STEMI	16(7.76%)	21(10.39%)	0.51
NSTEMI	32(15.53%)	33(16.33%)	0.79
UA	5(2.42%)	14(6.93%)	0.068
Stable CAD	154(74.75%)	138(68.31%)	0.28
Kind of intervention			
Coronarography	125(60.67%)	144(71.28%)	0.07
Coronarography and PCI	81(39.32%)	58(28.71%)	

Coronary angiography entry strategy seems to be influenced by clinical variables and doctor preference. Investigations were conducted on 206 radial and 202 femoral catheterizations. Radial and femoral catheterization radiation doses were 1.199 (0.677-2.001) and 1.218 (0.696-2.207) respectively, with a *p*-value of 0.88 indicating no difference in group radiation exposure. More contrast was used during radial catheterization (100, 70-200) than femoral catheterization (80, 60-150), *p*=0.029. The results of 122 femoral and 132 radial coronarography catheterizations were examined. Radial and femoral coronarography revealed radiation doses of 0.869 and 0.940 with p-values of 0.92, respectively. Contrast volume for radial coronarography (80, 60 to 100) was much smaller than for femoral (60, 50 to 80), *p*=0.008. 80 femoral and 74 radial catheterizations for angioplasty. The radiation doses for radial and femoral angioplasty were respectively 2.244 (1.689-3.0239) and 1.800 (1.188-3.00). Radiation exposure was equivalent between groups (*p*=0.41). With a *p*-value of 0.044 in table-2, radial angioplasty used more contrast (200, 160-200) than femoral (190, 100-200).

Table 2: Comparison of contrast dye volume and radiation dose (n = 408)

Analyzed group	Radial	Femoral	p-value
Catheterization			
Dose of radiation	1.218 (0.696-2.207)	1.199 (0.677-2.001)	0.88
(Gy)Contrast (ml)	100 (70-200)	80 (60-150)	0.029
Coronarography			
Dose of radiation (Gy)	0.869 (0.613-1.450)	0.940 (0.607-1.374)	0.92
Contrast (ml)	80 (60-100)	60 (50-80) 0.008	
Angioplasty			
Dose of radiation (Gy)	2.244 (1.689-3.0239)	1.800 (1.188-3.00)	0.41
Contrast (ml)	200 (160-200)	190 (100-200)	0.044

No hemorrhagic complications from radial or femoral catheterization, coronarography, or angioplasty were seen in the group analysis. During femoral catheterization, coronarography, and angioplasty, aneurysms and hematomas occurred. The p-values for angioplasty were 0.34, coronarography was 0.061, and femoral catheterization was 0.09. The *p*-value for local angioplasty issues was 0.51. However, there was a trend for more problems to occur in the femoral group, along with a Fisher exact test result that was borderline (*p*=0.061). It is significant to highlight that, despite the absence of statistically significant differences, as shown in Table 3, within the radial group.

Table 3: Complications of a percutaneous procedure.

Analyzed group	Radial	Femoral	p-value
Catheterization			
Hemorrhagic complications	0	7(3.46%)	0.09
Local complications (aneurysm + hematoma)	0	9 (4.45%)	0.06
Coronarography			
Hemorrhagic complications	0	0	0.19
Local complications (aneurysm + hematoma)	0	7(3.46%)	
Angioplasty			
Hemorrhagic complications	0	16 (7.92%)	0.04
Local complications (aneurysm + hematoma)	0	11 (5.44%)	0.51

DISCUSSION

Despite it entails an extended training trajectory,

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transradial coronary catheterization offers a promising screening as well as curative substitute over transfemoral entry. Technical hurdles are inevitable due to their makeup and composition. Numerous studies found a 4%-7% merge incidence using transradial injection [11, 12]. One case research by Louvard *et al.*, showed 8.9% transradial to transfemoral transition and 8.1% vice versa [13]. These may be due to octogenarians, small sample size, and an integrated angiogram and percutaneous procedure cohort. Kim and Yoon found 3.5% transition convergence [14]. By virtue of good radial instance decision-making, precise piercing methods, mild needle maneuver, and convoluted anatomy management. Given the nature of the tiny, spastic radial artery, penetration inability constitutes the initial transradial catheterization challenge. Radial strain and penetration inability are caused by hand discomfort. Pierce is supposed to be approximately ideal for radial accessibility. The separation between transradial entrance along with current access point crossover has reduced due to equipment advancements and skill. Rao with colleagues as well as Kawashima et al found a small variance in dye volume throughout the entire procedure, with decreased contrast volume in the transradial group [15, 16]. The larger proportion of post-CABG individuals belonging to the transfemoral category might be attributed towards the greater visualization dose and utilization of irradiation throughout the operation to visualize graft bypass vessels and native coronary vessels. This explanation additionally pertains to longer procedure durations within the femoral arm compared to the radial category, although the difference did not appear statistically significant. Post-procedural blood creatinine levels were not substantially elevated in either category, indicating potential contrast-induced nephropathy hazard remained unchanged. The two groups experienced similar exposures to radiation in a study by Brueck and collaborators reporting greater doses of radiation among the transradial to transfemoral arm.[17] A greater proportion of post-CABG instances in the transfemoral group contributed to this. In our study compared to the findings of Bruek, trans-femoral arm has reduced radiation intake [17]. Operator expertise significantly impacts success rate, operation length, and the level of radiation exposure. Moreover, in terms of radiation exposure, the results of this study back with previous studies that indicated no significant difference in radiation exposure between radial and femoral access [18, 19]. However, some research suggests that radial access may result in less radiation exposure [20, 21]. This might be because the radial artery is closer to the skin's surface, making it simpler to see and control during the process. Furthermore, the radial technique provides for a more secure catheter location, which reduces the need for many fluoroscopy shots [22, 23]. The findings of this investigation, however, imply that the difference in radiation exposure between radial and femoral access is not statistically significant.

CONCLUSIONS

The study participants noticed non-significant differences in contrast dye volume and radiation dose between femoral and radial coronary angiography. The growing demand and patient-preferred radial technique is equally effective and safe as the conventional femoral method for peri-procedural problems and does not elevate ionizing radiation consumption.

Authors Contribution

Conceptualization: H
Methodology: H
Formal analysis: MK
Writing, review and editing: H, MSA, AR, Z, NK

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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