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# COMPLICATIONS ASSOCIATED WITH FEMORAL ARTERY CANNULATION BY ANATOMICAL METHOD AND ULTRASOUND GUIDE TECHNIQUE

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**Abstract**

**Background:** Local vascular complications from femoral artery puncture include groin hematoma, retroperitoneal hematoma, vessel thrombosis, pseudoaneurysm, and arteriovenous fistula.

**Objective:** To compare the frequency of complications associated with femoral artery cannulation by anatomical method versus ultrasound-guided technique.

**Material and Methods:** Over the course of six months, from March 12, 2023, to September 11, 2023, this randomized controlled experiment was carried out at AFIC/NIHD, Rawalpindi. The research comprised 90 patients who had femoral artery coronary angiography coronary angiography, and they were divided into two groups at random. Group B got ultrasound-guided femoral artery cannulation, while Group A underwent anatomical technique of femoral artery cannulation. Following the operations, a resident cardiologist documented the findings and a consultant radiologist evaluated the net time consumed and the existence of retroperitoneal or localized hematoma.

**Results:** The research included ninety patients who were randomly assigned to a pair of groups, Group A (palpation technique) and Group B (ultrasound-guided method), for femoral artery coronary angiography coronary angiograms. Patients' ages ranged from 37.76 ± 9.49 years with an average to 25.6% female and 74.4% men. Comparing complications, Group A exhibited significantly higher rates of hematoma formation (33.33% vs. 8.89%, p=0.004), drop in blood pressure (33.33% vs. 13.33%, p=0.025), and blood transfusion (49% vs. 20%, p=0.04) compared to Group B. Additionally, age-stratified analysis revealed higher complication rates in Group A across both age categories (≤40 years and >40 years), with notable differences in hematoma formation, drop in blood pressure, and need for blood transfusions.

**Conclusion:** Compared to traditional artery catheterization, the ultrasound-guided technique increases first attempt success rates and reduces local-regional hematoma incidence in femoral artery catheterization.

**Key Words:** Artery Cannulation, Ultrasound-guided technique, Hematoma

## Introduction

Femoral artery cannulation is a common procedure in interventional cardiology, primarily used for diagnostic and therapeutic coronary angiography [1]. The technique's success and complication rates are crucial for patient outcomes and the overall efficacy of the intervention [2]. Traditionally, femoral artery access has been obtained using the anatomical landmark or palpation method, where the artery is located by feel [3]. Due to its affordability and ease of use, this approach has been used extensively, although it is not without issues [4]. The most common side effects are arteriovenous fistula, vascular thrombosis, groin hematoma, and retroperitoneal hematoma [5]. Significant morbidity and extended hospital stays brought on by these issues may have an adverse effect on patient recovery and healthcare expenses [6].

The technique of femoral artery cannulation with ultrasound assistance has become more and more common in recent years. With the use of real-time imaging to see the artery, this approach may enable a more accurate puncture with fewer problems [8]. According to many studies, femoral artery cannulation guided by ultrasonography has a higher success rate on first attempts and a lower risk of vascular problems [9–11]. The adoption of ultrasound guidance in clinical practice has been sluggish despite these encouraging results, in part because more equipment and training are required [12].

Furthermore, there is a dearth of recent local data confirming these results, despite the fact that many worldwide studies have examined the advantages of ultrasound-guided treatments over conventional approaches [13]. Since the bulk of research conducted to date has been done in contexts with various patient groups and healthcare systems, it is challenging to generalize the findings to all scenarios. Specifically, little data exists contrasting the anatomical and ultrasound-guided method rates of problems in the community hospital environment [14]. This discrepancy emphasizes the need of conducting a targeted study to ascertain the most efficient and secure technique for femoral artery cannulation in our patient population.

## Research Objective

To compare the frequency of complications associated with femoral artery cannulation by palpation method versus ultrasound-guided technique.

## Materials and Methods

### Study Design and Setting

During the six months from March 12, 2023, to September 11, 2023, this randomized controlled experiment was carried out at AFIC/NIHD, Rawalpindi.

### Sample Size

There were 90 patients total in the trial, 45 in each group. Based on proportions P1=3.7% and P2=22.5%, the sample size was computed with a power of 80% and a threshold for significance of 5%. The lottery approach was used to randomly allocate participants to one among both groups.

### Inclusion Criteria and Exclusion Criteria

Patients of either gender, aged 18-70 years, undergoing coronary angiogram through the femoral artery approach were included in the study. The research excluded patients with a history of bleeding issues or numerous femoral artery cannulations.

### Data Collection Procedure

The hospital's ethics committee granted ethical approval, and each subject provided signed informed permission. Patient details were recorded in a structured Performa (Annex A). Patients admitted for coronary angiogram through the femoral artery were randomly assigned to Group A (palpation method) or Group B (ultrasound-guided method) via lottery method. Cannulation for both groups was performed by a single consultant cardiologist to minimize bias. After the procedures, a consultant

radiologist assessed and recorded the net time and occurrence of localized or retroperitoneal hematoma. These assessments were documented by a resident cardiologist.

**Statistical Analysis**

SPSS version 23 was used for data analysis. Qualitative data like gender and complications were shown as frequencies and proportion, whereas quantitative ones like age were reported as mean and standard deviation. Stratification was used to account for impact variables like gender and age. Chi-square tests for post-stratification were used, and a p-value of less than 0.05 was deemed statistically significant.

**Results**

In a study involving 90 patients undergoing coronary angiogram via femoral artery approach, two groups were randomly assigned. Group A received femoral artery cannulation via palpation method, comprising 45 patients, with age distribution as follows: 18-30 years (10 patients, 22.22%), 31-40 years (21 patients, 46.67%), 41-50 years (10 patients, 22.22%), and >50 years (4 patients, 8.89%). Group B, with an equivalent size, underwent cannulation using ultrasound guidance, showing age distribution of: 18-30 years (12 patients, 26.67%), 31-40 years (18 patients, 40.00%), 41-50 years (9 patients, 20.00%), and >50 years (6 patients, 13.33%) (figure 1) and the average age of the patients was 37.76 ± 9.49 years. There were 67(74.4%) male and 23(25.6%) female as shown in figure 2.

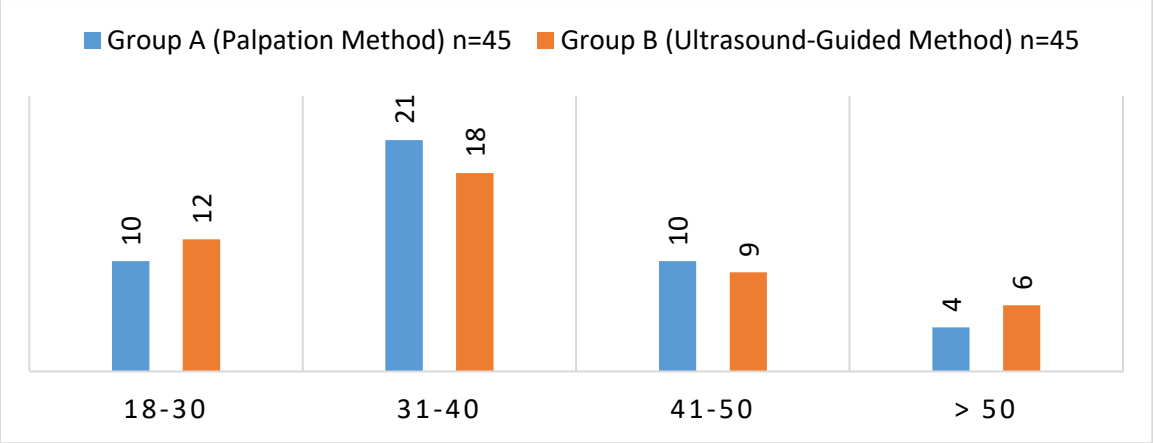


**Figure 1: Age Distribution of the Patients According to Groups N=90**

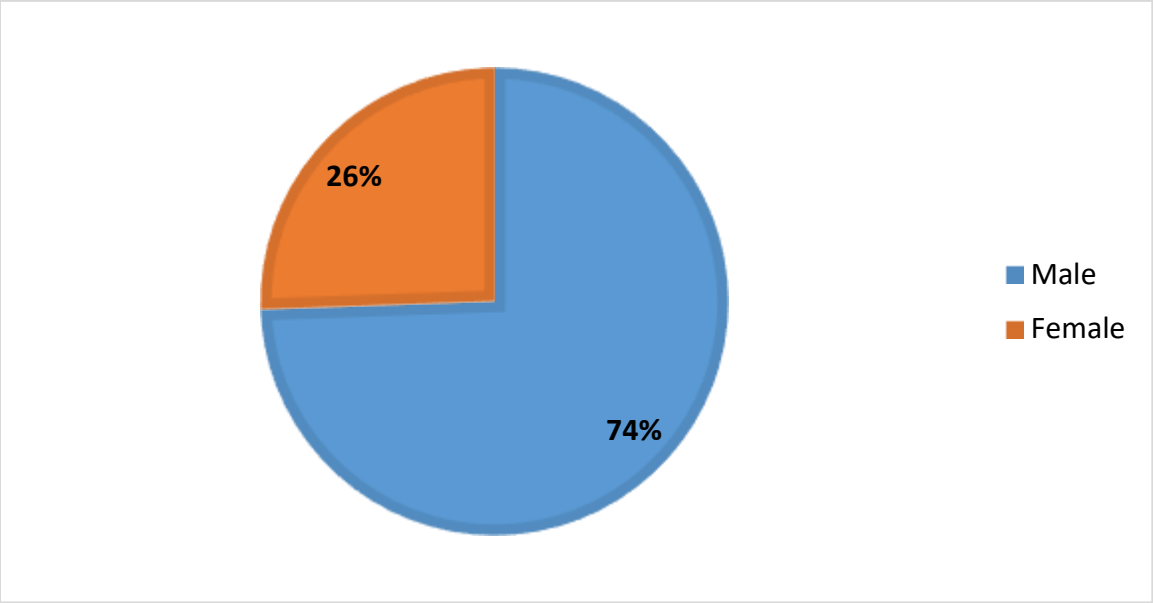


**Figure 2: Gender Distribution of Study Participants**

Table 1 compares complications associated with femoral artery cannulation using the anatomical method (Group A) versus the ultrasound-guided technique (Group B). Group A had significantly higher rates of hematoma formation (33.33% vs. 8.89%, p=0.004), drop in blood pressure (33.33% vs. 13.33%, p=0.025), and blood transfusion (49% vs. 20%, p=0.04) compared to Group B.

**Table 1: Complications Associated with Femoral Artery Cannulation by Anatomical Method and Ultrasound Guide Technique**

| Complication | Group A | Group B | p-Value |
|---|---|---|---|
| Hematoma Formation n (%) | 15 (33.33%) | 4 (8.89%) | 0.004 |
| Drop in Blood Pressure n (%) | 15 (33.33%) | 6 (13.33%) | 0.025 |
| Blood Transfusion n (%) | 22 (49%) | 9 (20%) | 0.04 |

In Table 2, complications after femoral artery cannulation by the anatomical approach (Group A) against the ultrasound-guided technique (Group B) are compared between patients ≤40 years and those >40 years. Hemostoma development was seen in 9 patients (29%) in Group A and 3 patients (10%) in Group B for patients aged 40 years or older (p=0.106). Nine patients (29%) in Group A saw a decline in blood pressure, compared to three patients (10%) in Group B (p=0.106). Additionally, 12 patients (38.7%) in Group A needed blood transfusions, compared to five patients (16.7%) in Group B (p=0.005). Hemostoma development was seen in 6 individuals (42.9%) in Group A and 1 patient (6.7%) in Group B for patients older than 40 (p=0.023). Blood transfusions were required for 10 patients (71.4%) in Group A compared to 4 patients (26.7%) in Group B (p=0.016), and 6 patients (42.9%) in Group A had a reduction in blood pressure compared to 3 patients (20%) in Group B (p=0.184).

**Table 2: Complications in Patients Aged ≤40 Years and >40 Years**

| Complication | | Group A | Group B | p-Value |
|---|---|---|---|---|
| **Patients Aged ≤40 Years** | Hematoma Formation n (%) | 9 (29%) | 3 (10%) | 0.106 |
| | Drop in Blood Pressure n (%) | 9 (29%) | 3 (10%) | 0.106 |
| | Blood Transfusion n (%) | 12 (38.7%) | 5 (16.7%) | 0.005 |
| **Patients Aged >40 Years** | Hematoma Formation n (%) | 6 (42.9%) | 1 (6.7%) | 0.023 |
| | Drop in Blood Pressure n (%) | 6 (42.9%) | 3 (20%) | 0.184 |
| | Blood Transfusion n (%) | 10 (71.4%) | 4 (26.7%) | 0.016 |

Table 3 compares complications in male and female patients undergoing femoral artery cannulation by the anatomical method (Group A) versus the ultrasound-guided technique (Group B). Among males, hematoma formation occurred in 11 patients (33.33%) in Group A versus 5 patients (14.71%) in Group B (p=0.091). A drop in blood pressure was observed in 16 males (48.48%) in Group A compared to 7 males (20.59%) in Group B (p=0.016), and blood transfusions were required for 11 males (33.33%) in Group A versus 3 males (8.82%) in Group B (p=0.014). Among females, hematoma formation occurred in 4 patients (33.33%) in Group A versus 1 patient (9.09%) in Group B (p=0.317). A drop in blood pressure was seen in 6 females (50.00%) in Group A compared to 2 females (18.18%) in Group B (p=0.193), and blood transfusions were needed for 4 females (33.33%) in Group A versus 1 female (9.09%) in Group B (p=0.317).

**Table 3: Complications in Male and Female Patients**

| Complication | Group A | Group B | p-Value | Group A | Group B | p-Value |
|---|---|---|---|---|---|---|
| | **Male** | | | **Female** | | |
| Hematoma Formation | 11 (33.33%) | 5 (14.71%) | 0.091 | 4 (33.33%) | 1 (9.09%) | 0.317 |
| Drop in Blood Pressure | 16 (48.48%) | 7 (20.59%) | 0.016 | 6 (50.00%) | 2 (18.18%) | 0.193 |
| Blood Transfusion | 11 (33.33%) | 3 (8.82%) | 0.014 | 4 (33.33%) | 1 (9.09%) | 0.317 |

**Discussion:**

One of the most important clinical skills is vascular cannulation. Adults and kids alike may benefit from peripheral, central, and arterial cannulation as frequent vascular access techniques. Although patients may have both minor and major issues, the outcome of these procedures mostly depends on the patient's anatomy, any comorbid conditions, and the operator's skill [15,16]. Vascular access has been achieved in clinical practice with ultrasonography guidance for more than thirty years. Target vessel vision has become more popular as a means of minimizing issues and increasing the success rate of vascular cannulation. Numerous studies have shown the safety, efficacy, and efficiency of ultrasound-guided vascular access in comparison to cannulation by anatomical landmarks and/or acoustic Doppler [17–19]. In order to evaluate the incidence of issues linked to femoral artery cannulation using the palpation method vs the ultrasound-guided technique, this research comprised 90 patients, ages ranging from 18 to 70 years, who had coronary angiography using the femoral artery approach. Two groups of patients were randomly assigned. Patients in Group B had ultrasound-guided femoral artery cannulation, while those in Group A underwent anatomical femoral artery cannulation. The average age of the patients was 37.76±9.49 years, with the majority being in the 31–40 year age range. Research has shown that the prevalence of coronary stenosis rises with age in participants aged 21 to 39 or 30 to 34 [20, 21], and that males are more likely than women to have atherosclerosis [22]. In our research, 67 patients (74.4%) were male and 23 patients (25.6%) were female. These results are consistent with research demonstrating that age-matched women had a much lower burden of obstructive and non-obstructive CAD than do males [23–26].

Compared to venous cannulation, ultrasound-guided arterial puncture has less literature documentation [27]. However, a meta-analysis [28] and expert consensus indicate that ultrasonic cannulation may be performed more quickly and simply than traditional landmark-based cannulation on the radial, ulnar, brachial, and femoral arteries. Our findings lend credence to the theory that the USG-guided femoral artery cannulation approach prevents hematoma development more effectively than the palpation technique. In comparison to group B (cannulation by ultrasound-guided approach), the frequency of hematoma development in group A (by anatomical method) was substantially higher (33.33% vs. 8.89%; p=0.004). Numerous additional studies corroborate our findings. M In their prospective, randomized, single-blinded experiment, Tremblay-Gravel et al. [29] reported Venous punctures and mild vascular problems are less common using the ultrasound-guided approach in individuals having cardiac catheterization via the femoral artery. The use of ultrasonic guiding during vascular guidance has been shown in several trials to dramatically prevent serious problems [30–32]. Additionally, Caiozzo et al. [33] and his team discovered that the use of U/S approach decreased the frequency of mechanical complications. In a research including 381 instances of internal jugular vein cannulation, Turker et al., [34] and associates found that the ultrasonography group had a noticeably decreased rate of arterial puncture and hematoma. By using sonographic methods to locate vessels more accurately, the insertion of CVCs may be performed in a safer, quicker, less complicated, and more frequently effective manner. Real-time ultrasonography clarifies the relative location of the needle, the vein, and the surrounding structures, which might be one reason for these advantages. With the use of two-dimensional ultrasonography, the user can assess the patency of a target vein (thrombosis, small diameter) and predict variant vascular anatomy (e.g., transposition of the vein and the artery, overlap of the artery and the vein) as well as abnormal patient anatomy (e.g., morbid obesity, cachexia, local scarring) prior to and during the procedure.

**Conclusion**

Our study underscores the advantages of ultrasound-guided femoral artery cannulation over the traditional palpation method. With a significant reduction in complications such as hematoma formation, blood pressure drops, and the need for blood transfusions, ultrasound guidance emerges as a superior technique. These findings emphasize the importance of incorporating ultrasound technology into routine clinical practice, offering safer and more efficient vascular access procedures, ultimately enhancing patient outcomes and healthcare quality.

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