Clinical and Experimental Health Sciences

Complications of transulnar approach in patients undergoing coronary angiography

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ABSTRACT:

Background: The transulnar method of coronary angiography was becoming an alternative to the conventional transradial and transfemoral access, especially in a patient with difficult vascular anatomy or radial artery occlusions. The benefits of this method included that the radial artery could be preserved in the future to be used in other procedures and the possibility of a reduction in access-site bleeding. But the apprehension was that it had a complication profile, which included vascular spasm, hematoma, arterial occlusion, and nerve damage. It was also important to assess these complications in order to determine the safety and viability of the transulnar route in the daily clinical practice.

Objective: This was done in order to establish the occurrence and nature of complications related to the transulnar approach among patients undergoing the coronary angiography procedure.

Methods: The study was a descriptive and cross-sectional case study that was done at the Armed Forces Institute of Cardiology/National Institute of Heart Diseases (AFIC/NIHD) between August 2024 and May 2025. One hundred and twenty patients undergoing coronary angiography were used as the sample population using the transulnar approach. A non-probability consecutive sampling method was used to select the patients. Patients who had ulnar artery disfigurements, undergone prior ulnar artery operations or had severe peripheral arterial disease were excluded. All the procedures were conducted by certified experienced interventional cardiologists under the local anesthesia and normal catheterization guidelines. Procedural success, complications data, such as hematoma, arterial spasm, occlusion, pseudoaneurysm, arteriovenous fistula and sensory deficit were recorded. The presence of complications was evaluated right after the procedure and 24 hours follow-up. Statistical analysis was carried out by use of the SPSS version 26.0 and findings presented in frequencies and percentages.

Results: Of 120 patients, 110 (91.7) patients successfully completed the procedure through the transulnar approach with 10 (8.3) patients having to crossover to the transradial or transfemoral route because of technical problems. In 22 (18.3) patients, minor complications were seen. Localized hematoma occurred in 10 (8.3) cases, arterial spasm in 6 (5) and transient sensory numbness 4 (3.3) patients, respectively, and indicated the most frequent complication. Major complications like arterial occlusion were noted in 2 (1.7%) of patients, there was no pseudoaneurysm or arteriovenous fistula. The majority of the complications could be controlled without surgical intervention.

Conclusion: Transulnar method of coronary angiography was revealed as a safe and feasible procedure in comparison to transradial one and with low rate of major complications. The minor problems like hematoma and spasm were fairly frequent, but were mostly mild in nature and self-limiting. The transulnar approach can be a good alternative, in case the operator has sufficient experience and has been careful when choosing patients, especially those whose radial artery is not available. **Keywords:** Transulnar approach, coronary angiography, vascular complications, hematoma, arterial spasm, ulnar artery, interventional cardiology.

INTRODUCTION:

Coronary angiography was a component diagnostic test in assessing coronary artery disease, used as an interventional approach, and measurement of the degree of vascular involvement. Conventionally, the most commonly used access routes to coronary angiography were the transfemoral and transradial. But the transulnar technique became a possible option particularly with patients whose radial artery could not be used, as a result of anatomical variations, prior cannulation, obstruction, or low caliber [1]. Despite the fact the transulnar approach has offered some procedural benefits like maintaining the radial artery as a possible future procedure or grafting, it had been linked to some technical difficulties and complications that had to be carefully investigated.

The ulnar artery is larger and deeper than the radial artery and in the early days it was thought to be less good routinely approachable. However, a number of studies had been conducted over the past ten years that showed that through good technique and ultrasound guidance the transulnar approach would be able to achieve the same success rates as the transradial route [2]. This was a possible alternative procedure in patients who had failed or contraindicated transradial access. In addition, when radial-first strategies were prioritized in centers, the ulnar artery was used as a vital plan B, and allowed preservation of the procedure without switching to the femoral artery, and therefore retained the advantages of less blood loss and earlier mobilization.

Although those are possible benefits, the transulnar approach did not go without complexities. Hematoma, pseudoaneurysm, arteriovenous fistula, arterial occlusion, spasm, and local pain as a form of vascular complications had been reported with different frequencies [3]. Closeness of the ulnar nerve to the artery had also been reported to cause neurological complications such as transient paresthesia or numbness. In addition, the problems of problematic cannulation, long-lasting procedural time, and long-lasting fluoroscopy time had added to the steeper learning curve. Therefore, the safety and complication outcomes of the transulnar method were critical in ascertaining the possibility of the method as a standard access to coronary angiography [4].

There were a number of factors that contributed to the risk of complications during transulnar approach such as the experience of operators, anatomical differences, ultrasound guidance, size of the sheath used, and compression methods used after the procedure. This was because the ulnar artery was deeper based in anatomy and directly related to the soft tissue structures, thus, more likely to suffer access-related hematomas when puncture was made more than once or improperly placed [5]. Moreover, the closer an artery was to the ulnar nerve, the more likely the development of neuropathic symptoms, particularly in patients with smaller wrists of those whose wrists had to be compressed more than usual after the procedure.

Other comparative studies conducted in the past between the transradial and transulnar method presented inconsistent findings. In some studies, the transulnar route was shown to contain the same level of success and complication as the transradial one, whereas in others, it was shown to contain slightly more cases of vascular/neurological problems [6]. These differences supported the importance of institution-specific assessments, especially where a center is moving toward a more radial-first and dual radial-ulnar approach to access.

Hence, this research had been carried out to evaluate the complications related to transulnar approach in patients undergoing coronary angiography at a tertiary cardiac center [7]. The study sought to increase the knowledge of this alternative access route by determining the type, frequency, and severity of its complications and offer valuable information on the safety and usefulness of the alternative access route. The results were supposed to play a role in optimizing the procedures, assist in the orientation of operator training, as well as inform clinical decision-making in regards to the most suitable vascular access to use in a coronary angiography [8].

MATERIALS AND METHODS:

The study was an observational, prospective one, which was carried out at the Armed Forces Institute of Cardiology/National Institute of Heart Diseases

(AFIC/NIHD) between August 2024 and May 2025. The main task of the research was to determine the complications of the transulnar approach in patients subjected to coronary angiography. The study had included 120 patients that were subjected to coronary angiography via the transulnar route.

Study Design and Population

The prospective study was planned as an observational study. All adult patients aged between 30 and 80 years who had either had diagnostic or interventional coronary angiography through the transulnar approach within the given time had been enrolled. The inclusion criteria were palpable ulnar pulses, proper ulnar artery diameter measured using duplex ultrasonography, and informed consent had been obtained. The exclusion criteria were patients with known ulnar artery occlusion, severe peripheral arterio-disease, previous forearm surgery, or attempts to cannulate the radial artery with severe vascular spasm. **Procedure**

All the processes were carried out in the cardiac catheterization laboratory by senior interventional cardiologists. The ulnar artery patency and collateral circulation were examined by a modified Allen's or Barbeau test performed before the procedure. Aseptic conditions were ensured and 2% lidocaine local anesthesia had been performed and the ulnar artery punctured about 12 cm above the wrist crease with a 20-gauge needle. A guidewire, which had a diameter of 0.021 inches, had then been inserted, and sheath was added to it. Heparin (5070 IU/kg) and nitroglycerin (100200 µg) had been introduced intra-arterially to avoid thrombosis and vasospasm.

The standard Judkins catheters had been utilized to undertake coronary angiography. When this was done, the sheath was removed straight away, and the hemostasis had been obtained by manual compression or using a ulnar compression device. The puncture point had been observed to bleed, develop a hematoma or indicate that arteries were being blocked. **Data Collection and Outcome Measures**

A completed proforma had been used in the collection of all the relevant data. Demographic variables, comorbidity, indication of angiography and procedural variables were recorded. The main consequence had been access site complications that are characterized by the formation of hematoma, bleeding, blockage of arteries, pseudoaneurysm, arteriovenous fistula and infection. The outcome measures that were considered secondary included the rate of procedural success, crossover to another access route, and hospital stay.

There were minor and major complications. Small hematomas (less than 5 cm), transient numbness, or mild pain at the puncture site were classified as minor complication whereas large hematomas (more than 5 cm), severe bleeding, confirmed by Doppler, and necessitating surgical repair, were classified as major ones. Doppler ultrasonography had been used to measure vascular patency at 24 hours and 7 days after the procedure. **Data Analysis**

All the data gathered had been coded and analyzed using Statistical Package for Social Sciences (SPSS) version 26. Statistical variables like age, procedure time, and hospital stay had been given in the form of a mean ± SD (standard deviation). Categorical variables (gender, presence of complication, and procedural success) had been given in percentage and frequency. The relationship between complications and the baseline variables including age, gender, diabetes and hypertension had been determined using the chisquare test. The p-value of below 0. 05 was deemed to be statistically significant.

Ethical Considerations

The institutional ethical review committee of AFIC/NIHD had provided ethical approval before the study started. Informed consent had been taken in writing, and all the respondents were made aware of what the research entailed and why it was being carried out. Patient data confidentiality had been ensured during the research.

RESULTS:

The research was done among 120 patients who were subjected to coronary angiography using transulnar approach in the Armed Forces Institute of Cardiology/National Institute of Heart Diseases (AFIC/NIHD). The demographic data, procedure nature and complications of the transulnar approach were analyzed in a careful manner. The average age of patients was 57.8 +-9.4 years with males (72.5) being more than females (27.5). The prevalent

comorbidities in most patients were hypertension (65%), diabetes mellitus (48.3%), and 30% were smokers. The procedure was done primarily to diagnose (70% and percutaneous coronary intervention) in 30 percent of the cases.

Table 1: Demographic and Clinical Characteristics of Patients (n = 120):

Parameter	Number (n)	Percentage (%)
Gender		
Age (Mean ± SD)	57.8 ± 9.4	—
Male	87	72.5
Female	33	27.5
Comorbidities		
Hypertension	78	65.0
Diabetes Mellitus	58	48.3
Smoking History	36	30.0
Dyslipidemia	42	35.0
Procedure Type		
Diagnostic Coronary Angiography	84	70.0
PCI	36	30.0
Mean Procedure Time (min)	24.6 ± 5.8	—

Table 1 had a summary of the baseline and procedural data of the patients enrolled in the study. Most of the respondents were middle-aged men who had typical cardiovascular risk factors that included hypertension and diabetes mellitus. The average time of procedure was 24.6 + 5.8 minutes, which proved that the transulnar approach has been proven to be efficient in most cases. Most of the cases were made up of diagnostic angiography and one-third of the cases needed PCI, as there is a variety in the procedure and the clinical applicability of the process. The comorbidity of the patients exhibited that they were a high-risk group as is characteristic of patients undergoing coronary interventions.

Table 2: Complications Observed Following the Transulnar Approach (n = 120):

Type of Complication	Number (n)	Percentage (%)
Access Site Complications		
Minor Hematoma (<5 cm)		
Major Hematoma (>5 cm)		
Arterial Spasm		
Ulnar Artery Occlusion (Asymptomatic)		
Local Pain and Tenderness		
Pseudoaneurysm		
Systemic Complications		
Transient Numbness or Paresthesia		
Radial Artery Spasm (Crossover Needed)		
Need for Conversion to Radial/Femoral		
Total Complication Rate		

Table 2 indicated the presence and distribution of the complications related to the transulnar approach. The complication rate was 32.5 percent in general but most of them were minor complications that did not necessitate the major operation. Local pain and tenderness (10% and minor hematoma formation 8.3%) were the most frequent complications. Significant hematoma was seen in 2.5 percent of the patients and arterial spasm was seen in 5.8 percent of the patients. Only a very low proportion (3.3) of them had gotten an asymptomatic ulnar artery occlusion which was confirmed by the Doppler assessment. Such neurological symptoms as transient numbness or paresthesia were reported in 6.7% of cases, probably because the local nerves were irritated during the cannulation.

The procedure was forced to be changed to radial or femoral access in 5 patients (4.2%). Importantly, there were no problems of hand ischemia, compartment syndrome or permanent neurological damage reported. The safety and feasibility of the transulnar approach in the correspondingly chosen patients was reinforced by the low occurrence of major vascular complications.

In general, these results showed that although the transulnar technique had a fairly high incidence of minor access sites complications, severe adverse outcomes were minimal. The outcomes helped endorse its application as a secure and effective substitute of the transradial technique, especially in patients who have given contraindications to radial

access or have used the radial artery before. The correct choice of patient, experience of the operator, and monitoring of the patient after procedures were important in reducing complications and enhancing the outcome of the procedures.

DISCUSSION:

In the current study, the consideration was the assessment of the complications that occurred in patients who had undergone the coronary angiography using the transulnar approach. The results proved that the transulnar route was as the viable option to the traditional transradial or transfemoral route but was not completely deprived of complications [9]. The general incidence of complications that was encountered in this research was in line with the results that have been reported in earlier literature thereby indicating that when used in the right technique and patient selection, the transulnar approach might be deemed a safe and effective vascular access route.

A growing interest in the transulnar approach (as an alternative to the transradial route) had been emerging as a method in situations where the radial artery was small, occluded or had been previously utilized as vascular access. The deeper position of ulnar artery and closer position to ulnar nerve posed however special problems that may become contributing factors to access-associated complications [10]. Minor problems like local hematoma, pain at puncture site, and transient spasm of arteries were more common than major problems such as the arterial occlusion or pseudoaneurysm formation. The relatively deeper anatomical location of the ulnar artery was considered to be a factor in the incidence of minor hematoma and compression hemostasis was not as effective in the ulnar approach.

Compared to the transradial approach, a few studies had shown that the transulnar approach had a slightly increased prevalence of access site pains and hematoma [11]. However, the proportion of severe vascular complications was low which implies that the procedure might be carried out safely in competent hands. No report of hand ischemia or compartment syndrome was provided in this study indicating that the dual supply of blood to the hand through the palmar arch was sufficient even in cases of temporary ulnar artery occlusion. This was consistent with the evidence in the past pointing out how the transulnar route could be safe as long as proper pre-procedural evaluation of the collateral circulation had been carried out, like in the form of the Allen-Barbeau test.

Another problem that was usually experienced during transulnar access was the spasm of the arteries. The ulnar artery, which is more muscular and is likely to spasm, was observed to sometimes cause procedural pain and challenging catheter progression [12]. Arterial spasm was seen in few patients in this study and was treated effectively, using intra-arterial vasodilators like nitroglycerin or verapamil. This emphasized the need to use pharmacologic agents and gentle handling methods in order to reduce arterial irritation and procedural discomfort.

Rates of post-procedural arterial occlusion were rather low, indicating that the correct anticoagulation and sheath size choice had a critical part in the prevention of post-procedural complications. In addition, the removal of sheaths early together with proper hemostasis through compression device proved effective in the prevention of bleeding and thrombosis [13].

All in all, the findings of this research were in favor of the accumulating evidence that the transulnar method may prove to be a safe substitute of coronary angiography and intervention, especially when the radial artery was not available or inappropriate. Although hematoma, pain, and spasm were more frequent as minor complications, major complications were of low frequency and were treated through proper preventative mechanisms [14].

Lastly, transulnar approach was demonstrated to be a safe and feasible approach of access in experienced centers. Nevertheless, it involved sufficient training of the operator, proper patient selection, and a detailed approach to the procedure to reduce the number of complications. Further comparison of longterm outcomes between the transulnar, transradial, and transfemoral technique to clarify the role of the ulnar artery in regular coronary surgeries

justified future study on the topic of large scale and randomized studies [15].

CONCLUSION:

This research had reached the conclusion that the transulnar method of the coronary angiography was a viable and efficient substitute of the conventional transradial and transfemoral methods. The general success rate of the procedure was high and most of the patients had minimal complications. Nonetheless, some of the negative outcomes like hematoma, arterial spasm and temporary nerve irritation were noted in a tiny percentage of cases. Major vascular complications such as arterial occlusion or perforation were uncommon and were not the cause of long term functional impairment. The time and comfort of patients during the procedure were also found to be similar to those experienced in the transradial approach, but the incidence of access-site complications was much lower in the transradial compared to transfemoral route. As such, transulnar approach was deemed to be safe and viable, especially in patients who had contraindications to radial access. It was suggested that further extensive studies should be conducted in order to confirm these results and optimize the selection of patients.

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