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Outcome of Ipsilateral Ulnar Artery Cannulation in Failed Ipsilateral Radial Cannulation

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ABSTRACT

Objectives: This report aimed to assess the success rate of utilizing an ipsilateral ulnar artery where attempted or when added in conjunction with the attempted or used radial artery approach. **Materials and Methods:** An exploratory quantitative methodology is being followed in a prospective, observational study design of six months conducted at a tertiary care hospital in Pakistan. A convenient sample of 50 patients with failed radial artery cannulation was used. Ulnar artery cannulation was performed using ultrasound. Patients who required arterial access were adults and were excluded if they had known ulnar artery disease. The procedural success, the incidence of procedural-related complications, and the time to return to daily activities were measured. **Results:** The ipsilateral ulnar artery cannulation rate was 94%, with very few complications, including hematoma (4%) and arterial spasm (2%). Dissections of the nerves and arterial thrombosis were not observed. Most patients had a brief hospital stay and were discharged within 24 to 48 hours. Outcome assessment at 30 days postoperative did not reveal any serious complications lasting several months postoperatively. **Conclusion:** Ipsilateral ulnar artery cannulation is a safe and efficient approach as radial entry, with high success rates, low complication rates, and quick postprocedural recovery.

INTRODUCTION

The attempt to cannulate the ipsilateral ulnar artery after the inability to do so in the ipsilateral radial artery has recently attracted interest as an effective approach to vascular access, especially in patients who may need diagnostic or therapeutic interventions, including coronary angiography or catheterization. The radial artery is used frequently for arterial access given its position in emulators and comparatively fewer complications however, variations in this artery, spasm or occlusion may lead to failed cases of radial artery access, and the ulnar artery could be explored to continue with the procedures as may be advised (1). This approach has generated clinical interest because of its safety and practicality and its possibility of decreasing the risk of complications in those patients in whom radial access is not available (2).

Rare complications associated with radial artery cannulation include failure rates, which affect a small but important patient population, including patients with small, tortuous or obstructed radial arteries (3). If the radial site is not possible, the median ulnar artery could be used because of its location. The technique of ulnar artery cannulation has various studies regarding its efficiency and its function of preserving the continuation of the procedure without having to switch to a more invasive approach, such as the

femoral artery, which has also been reviewed extensively (4).

In various categories of patients, many investigators have pointed out that the alternative donor site can be the ulnar artery. Zafirovska et al. (2022) showed that ipsilateral ulnar artery access after failed radial access is relatively safe, and the associated complication incidence is relatively low thrombosis and arterial spasm occurred in 1 case. While others have studied the ways of resourcing designing the procedural technique or reviewing the complication risks associated with the procedure, it has been shown that other methods, such as using two sheaths in the same arm, offer flexibility to the traditional method and patients (5).

Furthermore, the ulnar artery is regarded as less sensitive to spasms than the radial artery, especially in patients with a history of radial artery spasms or those with defective radial artery pulse (6). For this reason, ulnar artery cannulation is a more appealing procedure, especially for patients likely to experience radial artery complications. Regarding hand function, both radial and ulnar artery cannulation were compared to measure long-term effects like grip strength and hand function. Samir et al. (2024) indicated that both access methods are inconsequential to hand function in the long-term follow-up, though radial access is associated with more transient pain (2).

The procedural success of ipsilateral ulnar artery cannulation to what has been enhanced catheterization methods and ultrasound guidance. It enhances the identification of the ulnar artery with the least interference on the vascular structure and is particularly useful in difficult vascular anatomic areas (7). Moreover, the efficiency of two-site hemostasis and the possibility of further modification of the TR bands to stimulate clotting and stop bleeding have been examined to increase patients' safety during ulnar artery cannulation (3).

Depending on the anatomical position and the preparedness of the medical team, the right choice of radial or ulnar artery cannulation is made. The literature has indicated that there is likely to be more benefit for patients at high risk of radial artery complications, including patients with diminished radial artery diameter and those with prior vascular events who use ulnar artery access (8). Thus, the most useful method is using ulnar artery cannulation as the secondary approach if radial access is problematic while reducing procedural disruptions and risks associated with the more aggressive approaches (9).

However, it is not without complications, such as the flow rate in the ipsilateral ulnar artery cannulation and the possibility of arterial thrombosis, nerve injury, and hematoma formation, among other complications. However, following these complications, several case reports suggest that these should never be overlooked, especially when using this method, since it requires proper patient selection and highly skilled technique (10). Consequently, determining the outcomes and potential advantages and drawbacks of utilizing the ulnar artery after radial failure is an essential direction of study in vascular intercession.

The study on ipsilateral ulnar artery cannulation has also proceeded as a related procedure to the election because of the incidence of complications involving the radial artery. This is especially notable in clinical practice settings in Pakistan, where there is a shortage of literature regarding the safety profile, early and late outcomes, and complications, if any, related to such practice. This study proposes to enhance knowledge about the abovementioned procedure's consequences in Pakistan and improve the characteristics of managing patients who underwent invasive cardiovascular procedures (11).

Finally, ipsilateral ulnar artery cannulation after failure of radial artery access constitutes a research focus in arterial intervention. Suppose a month's ongoing research depicts this method as safe and effective. In that case, it will be quite clear that the ulnar artery can offer the same service to patients as radial access in certain patients. More studies should, however, be conducted to define the methods and evaluate the late results of this procedure across different population groups, especially Asians, about the aspect of radial artery complications in Pakistani healthcare facilities that could be dissimilar (12). By doing so, healthcare practitioners can provide the patient with improved vessel access options and improve the procedure's success rate and patient satisfaction.

OBJECTIVE

This study aims to assess the effectiveness of ipsilateral ulnar artery cannulation in a clinical setting in Pakistan after the failure of radial artery cannulation by assessing procedural safety, post-procedure complications, patient recovery time, and alteration in long-term vascular functions.

MATERIALS AND METHODS

Study Design: This is a prospective observational study to evaluate the results of ipsilateral ulnar artery cannulation in case of failure of radial artery cannulation. This analysis pays more attention to the procedural success rate, complications, and post-procedural recovery of patients.

Study setting: The present research was conducted at the National Institute of Cardiology, Karachi, Pakistan, a cardiology teaching hospital and centre of repute where cardiovascular services and procedures are performed.

Duration of the study: The study was planned over one year, from January 2023 to December 2023, to ensure enough time was given to data collection and patient monitoring.

Inclusion Criteria

The trial enrolled non-pregnant patients 18 to 80 years old with appropriate indications for arterial invasive diagnostic or therapeutic procedures. However, patients who had failed radial artery cannulation and for whom ipsilateral ulnar artery cannulation was attempted were included in the present study. This group was chosen to assess the feasibility and safety of employing the ulnar artery as an additional option where radial artery access had not been attained.

Exclusion Criteria

Patients with bilateral radial and ulnar artery occlusion were excluded because both arteries cannot be used for cannulation. Moreover, patients with conditions they believed to be contraindicated arterial cannulation, like severe peripheral vascular disease, were excluded because the flow probe would likely be complicated when used in such patients. Patients who were diagnosed with an active infection or sepsis were also excluded from this study to prevent terrible consequences arising from the performance of the procedure. Finally, pregnant women were not included in the data because arterial access in pregnant people poses certain risks.

METHODS

With informed consent, the patients that met the inclusion criteria were included in the study. After the attempts for radial artery cannulation were abandoned, the ipsilateral ulnar artery was approached by conventional methods. Using ultrasound was useful in locating the position of the ulnar artery and checking its viability before cannulation. A 5-French sheath was securely sutured into the ulnar artery, and the appropriate waveform was obtained in the monitor, confirming arterial access. All patients received ulnar artery cannulation by interventional cardiologists or vascular surgeons with prior experience in the procedure.

Arterial spasm, thrombosis, hematoma formation, and nerve injury were observed and documented intra and post-procedure at 24 h. All patients were followed up for 30 days to look for any delayed complications, including occlusion or functional disability of the hand. The procedural success rate, complications, and recovery rate of patients who underwent ulnar artery cannulation were also statistically analyzed.

RESULTS

Fifty patients with failed radial artery access who later required ipsilateral ulnar artery cannulation were asked to participate in the study. The patients were composed of slightly more females than male patients. They had a mean age of 58.3±10.4 years. Of these, 60% of individuals who participated in the study were males, while 40% were females. Seventy-two per cent of the study patients had documented risk factors for cardiovascular diseases, including CAD and hypertension. They were undergoing diagnostic or interventional procedures, including coronary angiography or angioplasty.

One procedural success of ipsilateral ulnar artery cannulation was achieved in 94% of the attempts, with 47 of 50 successful cases. The failure was observed in three cases because of anatomical challenges to visualize the ulnar artery despite exploration and was subsequently replaced with femoral access. Thus, the average time of successful ulnar artery cannulation was 8.5±2.3 minutes.

Table 1
Demographics and Procedural Success

Variable	Value
Total number of patients	50
Mean age (years)	58.3 ± 10.4
Male patients (%)	60%
Female patients (%)	40%
Procedural success rate (%)	94%

The incidence of complications associated with using the ulnar artery cannulation was relatively low. Minor hematoma formation at the access site was the most frequent complication reported in 4 percent of the patients. Arterial spasm was reported in 2 percent of cases, and no patients complained of nerve injury or arterial thrombosis. Out of one patient who reported temporary paresthesia, the symptoms were gone after forty-eight hours.

Regarding long-term complications after the procedure, 48 patients had an uncomplicated recovery. Two patients had to undergo a second attempt at femoral artery access because of right ulnar catheterization. The length of hospital stay following the procedure averaged 1.2 ± 0.5 days in our patients. No further changes in the affected hand's grip strength and finger dexterity were observed during subsequent rehabilitation follow-up over the one month.

Table 2
Complications and Post-procedural Recovery

Complication Type	Number of Cases	Percentage (%)
Hematoma	2	4%
Arterial spasm	1	2%
Nerve injury	0	0%
Temporary paresthesia	1	2%
Need for femoral access	2	4%

No patient developed ulnar artery occlusion at the 30-day follow-up, nor was there any long-term functional disability identified. A comparison between grip strength before and after the stroke in affected and unaffected hands gave a mean grip strength of 28.6 ± 5.4 kg and 29.1 ± 5.6 kg, respectively, indicating that grip strength is not adversely affected in affected hands after a stroke. The chronic pain or paresthesia of the affected hand is also absent, evidenced by the patient's complaint.

Table 3
Functional Outcomes at 30-day Follow-up

Outcome	Affected Hand	Unaffected Hand
Grip strength (kg)	28.6 ± 5.4	29.1 ± 5.6
Finger dexterity (score)	9.2 ± 1.3	9.3 ± 1.2
Pain (Visual Analog Scale)	0.5 ± 0.4	0.4 ± 0.3

Finally, ipsilateral use of the ulnar artery when the radial artery is not accessible was presented as a safe approach with a high success rate and minor adverse events. Most patients reported no substantial changes in hand functioning, and the overall acceptance was good with a short recluse period.

DISCUSSION

This study affirms that ipsilateral ulnar artery cannulation after failed radial artery cannulation is feasible, safe and effective. Consequently, the highest success was achieved with fewer difficulties from the carried-out procedure, and this feedback is aligned with what has been postulated in other related research works. The overall success rate of 94% and fairly low rates of complications indicate that the given technique can be a useful spare method in cases with failed radial artery access and can be used for effective treatment without augmentation of femoral artery cannulation.

The high success rate noted in this work corroborates other research studies that focused on the ipsilateral ulnar artery cannulation. Zafirovska et al. (1) similarly validated the procedure's effectiveness in addressing 95 % of the failed radial artery access cases using the ulnar artery. In the same regard, Roghani-Dehkordi et al. (10) reported that the subsequent cannulation of the ulnar artery was successful in many patients with the previous failure in the radial artery. This implies that, despite some difficulty in visualizing and engaging the ulnar artery due to the anatomic arrangement and size and tortuosity of the vessels in some cases, general and even in special difficult cases, success rates of the cannulation are high.

The complications noted here were few even with them, US ultrasound-guided cannulation does not appear dangerous. Hematoma was the most frequent complication, presented in 4 % of patients, and it was also well-matched with the findings of other research. Hematomas were reported by Bahrami et al. (4) to occur in 3.5% of the cases if ulnar artery cannulation was carried out, and Tehrani et al. (6) also recorded a similar

complication rate of 4%. These complications were largely asymptomatic and rarely demanded rigorous medical attention to prove the procedure's safety. Arterial spasm, noted in 2 % of the patients in our study, is possible in any procedure involving arterial access, radial or ulnar line. This complication was temporary and was not followed by any other problems, similar to the observation made by Samir et al. (2), who opined that arterial spasms were rare and usually did not require any serious management intervention.

Most importantly, our study showed no nerve injury and arterial thrombosis, clearly showing the safety of performing the ulnar artery approach. Nevertheless, several works on radial artery cannulation described nerve damage or thromboembolic events that are the well-known side effects of arterial access (3). This study has important implications because it identifies the possibility that the ulnar artery cannulation approach could pose less of a threat to the structural and neural components of the brachial limb than radial entry, particularly in patients with structural anomalies or prior radial artery procedures.

The outcome after the procedure was also good in this study, with most patients having an unremarkable post-procedure course. The average length of a hospital stay was low and ranged from 24 to 48 hours of admission. This recovery time accords with the observation by Aoi et al. (3) regarding the recovery time of patients who received ulnar artery access following failed radial cannulation to those who received successful radial access procedures. This indicates that ipsilateral ulnar artery cannulation was not associated with prolonged recovery or hospital stays, so this should be favoured for patients undergoing interventional procedures that require arterial access.

Concerning the evaluations of the outcome of the late results of the study, it was observed that no patient had ulnar artery occlusion or functional impairment at the 30-day follow-up in this case. Other authors have illustrated the same by arguing that such ulnar artery cannulation does not lead to complications below the elbow, for instance, occlusion or chronic pain. In the short term and of the initial studies, no complications were described, as mentioned by Zafirovska et al. (1). Everybody was able to have normal hand functions, and the ulnar artery remained patent in most of the patients. Detailed findings of the present research endorse reporting ulnar artery cannulation as a safe and long-term alternative to radial artery involvement.

In the present study, the scenario of using ultrasound as a guide to ulnar artery cannulation also contributed significantly to the results observed above. The use of ultrasound in arterial cannulation is witnessing increased acceptance, especially in complex situations influenced by outcomes related to anatomical features. Nadagoudar and Panchgar (11) conclude that ultrasound value increases the chances of arterial access success due to visual enhancement by ultrasound coupled with the precision required in placing the cannula. In this investigation, before the procedure, the position of the ulnar artery was identified using ultrasound to predisposition access safety and practicality. This technique might have reduced the sheath's accidental arterial puncture or wrong positioning.

Furthermore, the present study showed that ipsilateral ulnar artery cannulation may be a suitable, less invasive alternative to femoral artery cannulation. Femoral access is linked with an increased risk of complications such as bleeding, infection, and vascular (12). Using the ulnar artery in cases of radial failure is safer and regional among patients who may experience complications in the femoral arteries. The current study's result highlights the need for multiple options when patients receive arterial cannulation, especially during emergency or high-risk situations.

Though the study's findings present positive outcomes, there are some limitations. First, generalization of the findings is restricted because the study was conducted on 50 patients, and the sample size is relatively small for identifying all types of complications or the patient's long-term effects. Further operational and larger scale studies with longer follow-ups have to be carried out on the results to have interim work done on the risks and benefits associated with ulnar artery cannulation. However, the study was performed in a single centre. Thus, the results cannot be extended to other centres or patient groups. The results of this single-centre study suggest that future multicenter studies with a larger and more diverse population sample are required for confirmation.

Finally, the approach to ipsilateral ulnar artery cannulation when radial artery cannulation has failed is also safe, efficient, and dependable. It has a very high success rate and few adverse effects. The use of ultrasound improves the efficacy of the procedures, the recovery time is minimal, and the postinterventional complications noted in patients are minor. This technique is a valuable option for patients with arterial access when radial access is impossible.

CONCLUSION

Ulnar artery cannulation in the same arm in patients when radial artery access is not successful is a highly effective and very safe procedure despite the relatively high success rate and rare complication rate. This work also shows that such an approach is possible with minimal hematoma and arterial spasm, no nerve injury, and no long-term artery occlusion. The use of ultrasound in the process significantly depends on how precise this method has to be to avoid endangering the patient and take minimum time. Moreover, the recovery period is brief, hospital days do not seem lengthened, and postprocedural complications are not heightened. It still remains a clinically reasonable treatment option if the patient cannot undergo radial artery technique hence, avoiding femoral artery cannulation is less safe. With these concerns in mind, ipsilateral ulnar artery cannulation must be considered useful and safe, enhancing positive outcomes and diminishing patient risks. Besides, it is suggested that similar studies with a bigger sample be conducted to reinforce these results.

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