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FREQUENCY OF LOSS OF RADIAL PULSE IN PATIENTS UNDERGOING TRANSRADIAL CORONARY CATHETERIZATION

Original Research

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ABSTRACT

Background: The transradial approach (TRA) has emerged as the preferred access route for coronary catheterization, offering reduced bleeding complications, earlier ambulation, and improved patient comfort compared to transfemoral access. Despite these benefits, radial artery occlusion (RAO)—often manifesting as loss of radial pulse—remains the most frequent complication of TRA. Although frequently asymptomatic due to dual hand blood supply, RAO can compromise future use of the radial artery for coronary interventions, dialysis access, or bypass grafting. Identifying its frequency and associated risk factors is crucial for prevention and long-term vascular preservation.

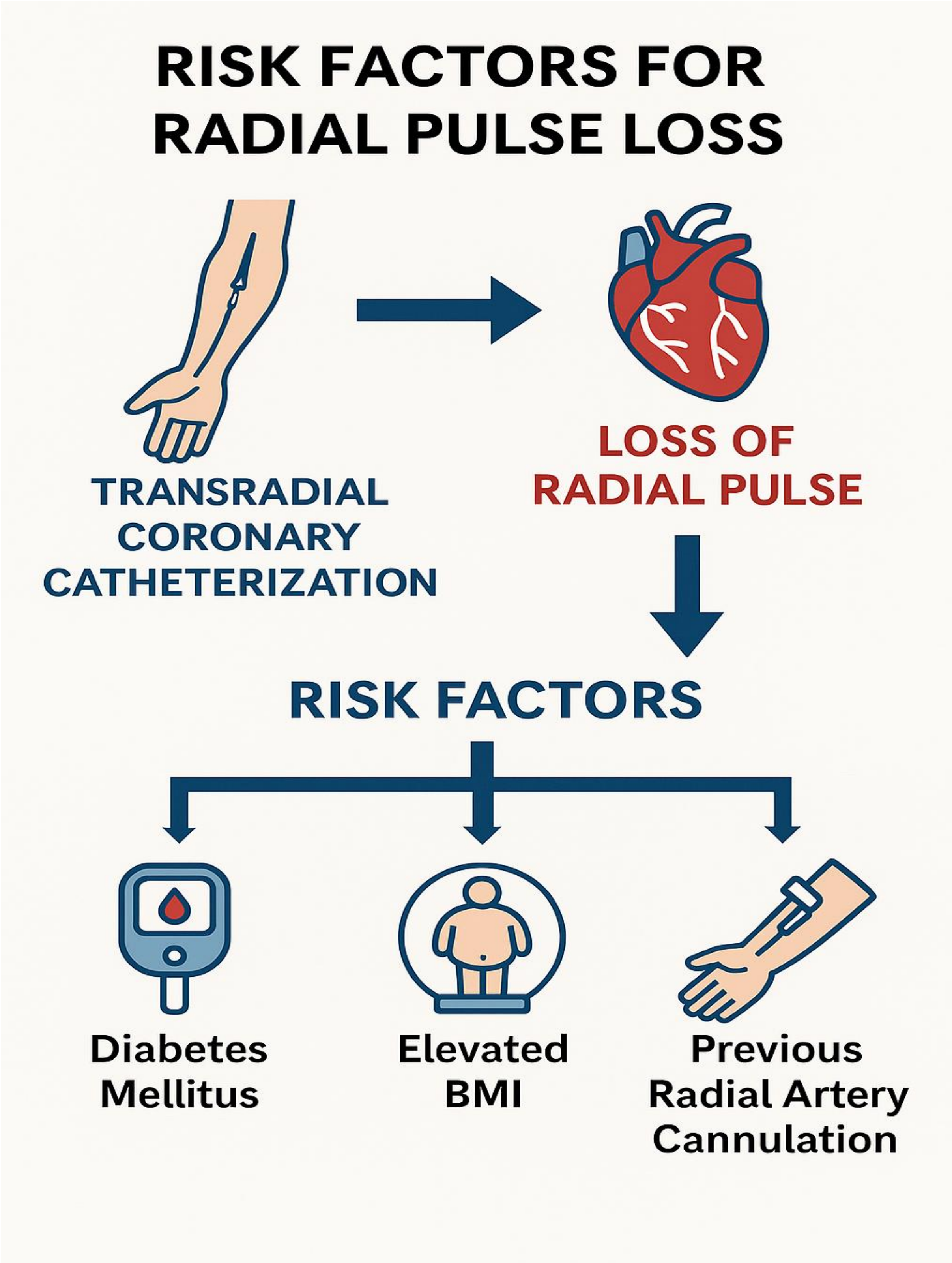
Objective: To determine the frequency of loss of radial pulse and its associated risk factors in patients undergoing transradial coronary catheterization.

Methods: This descriptive study was conducted over six months at the Department of Cardiology, Lady Reading Hospital, Peshawar. A total of 113 patients with coronary artery disease, aged 25–70 years, who met predefined inclusion criteria, underwent transradial coronary catheterization. Post-procedural loss of radial pulse was assessed at 24 hours using the Reverse Barbeau Test and confirmed via Doppler ultrasound. Data were analyzed using SPSS version 26. Categorical variables were reported as frequencies and percentages, continuous variables as mean ± standard deviation, and associations tested using Chi-square or Fisher's exact test, with $p \leq 0.05$ considered statistically significant.

Results: The mean age was 56.3 ± 8.9 years; 68 patients (60.2%) were male and 45 (39.8%) female. Hypertension was present in 62 patients (54.9%), diabetes mellitus in 48 (42.5%), and previous radial cannulation in 17 (15.0%). Loss of radial pulse occurred in 13 patients (11.5%). Significant associations were found with diabetes mellitus (61.5%, $p = 0.044$), BMI > 27 kg/m² (76.9%, $p = 0.038$), and previous radial cannulation (38.5%, $p = 0.031$). Gender, age, and hypertension were not significantly associated.

Conclusion: Loss of radial pulse after TRA was consistent with global trends, with metabolic factors and prior radial access as significant predictors. Pre-procedural risk stratification, patent hemostasis, and routine post-procedure patency checks are essential to reduce RAO risk and preserve future vascular access.

Keywords: Body Mass Index, Coronary Artery Disease, Doppler Ultrasonography, Radial Artery, Radial Artery Occlusion, Transradial Coronary Catheterization, Vascular Patency.


RISK FACTORS FOR
RADIAL PULSE LOSS
TRANSRADIAL
CORONARY
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LOSS OF
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RISK FACTORS
Diabetes
Mellitus
Elevated
BMI
Previous
Radial Artery
Cannulation

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INTRODUCTION

Coronary artery disease (CAD) remains one of the leading causes of morbidity and mortality in developing countries, posing a significant public health burden despite advances in diagnosis and treatment strategies. Although global mortality rates from CAD have declined over the past seven decades, the disease continues to account for approximately one-third or more of all deaths among individuals over the age of 55 years (1). Coronary angiography has emerged as the gold standard for diagnosing and formulating treatment strategies for atherosclerotic CAD, with access typically achieved through the femoral, radial, or ulnar arteries (2). Historically, the common femoral artery has been the preferred access site for coronary angiography and angioplasty; however, its use is frequently associated with vascular access site complications such as bleeding, hematoma, arteriovenous fistula, and pseudoaneurysm (3). These bleeding complications carry substantial clinical implications, including increased risks of death, myocardial infarction (MI), stroke, stent thrombosis, and higher healthcare costs. The majority of bleeding complications in patients undergoing percutaneous coronary intervention (PCI) originate from the vascular access site. In this context, the radial artery offers distinct advantages over the femoral artery, as it is anatomically superficial, more accessible, and easily compressible (4). The transradial approach (TRA) has therefore gained prominence, demonstrating reduced rates of access site bleeding—particularly in patients receiving aggressive antiplatelet and anticoagulation therapy—while also allowing earlier ambulation and improving patient comfort (5). Reflecting these benefits, the European Society of Cardiology Guidelines on Myocardial Revascularization recommend radial access as the standard approach for coronary angiography and angioplasty, provided that no overriding procedural requirements dictate otherwise (6).

Despite these advantages, radial artery occlusion (RAO) remains the most common and potentially consequential complication of TRA, often referred to as the “Achilles’ heel” of this technique (7). While RAO is frequently asymptomatic due to extensive collateral circulation from the palmar arch and forearm arterioles, it precludes future use of the radial artery for coronary interventions, intra-arterial pressure monitoring, or as a conduit in coronary artery bypass grafting (8,9). In a study, the frequency of loss of radial pulse was reported at 11.97% among patients undergoing transradial coronary catheterization (10). The local prevalence of this complication, however, remains insufficiently documented, representing an important gap in evidence that could influence clinical decision-making. Determining the frequency of radial pulse loss following transradial coronary catheterization in the local population is essential for guiding interventional cardiologists in assessing the risk–benefit balance of TRA. Such data can inform access site selection, improve patient counseling, preserve future vascular access options, and support the development of preventive strategies aimed at reducing RAO incidence. This study, therefore, aims to determine the frequency of loss of radial pulse in patients undergoing transradial coronary catheterization, thereby contributing to evidence-based refinements in procedural practice and ensuring the safe, effective, and sustainable use of this important technique in the local context.

METHODS

This descriptive study was conducted in the Department of Cardiology at Lady Reading Hospital (LRH), Peshawar, over a period of six months following approval of the research synopsis by the institutional ethical review committee and the College of Physicians and Surgeons Pakistan (CPSP). Ethical approval reference number was recorded, and written informed consent was obtained from all participants prior to enrolment, ensuring adherence to the principles of the Declaration of Helsinki. The study population comprised 113 patients, with the sample size calculated using the WHO sample size calculator based on a 95% confidence interval, a 6% margin of error, and an expected frequency of radial artery occlusion (RAO) of 11.97% (9). A non-probability consecutive sampling technique was employed to recruit eligible participants. Patients of either gender aged between 25 and 70 years, diagnosed with coronary artery disease and undergoing transradial coronary catheterization with a positive Allen’s test—defined as hand flushing within 5 to 15 seconds—were included. Exclusion criteria comprised previous arterial puncture in the same arm, peripheral artery disease, history of trauma or surgery to the radial artery, cardiogenic shock, chronic kidney disease stage 4 or 5, bleeding disorders, and confirmed pregnancy. Baseline demographic and clinical variables, including age, gender, body mass index (BMI), socioeconomic status, education level, place of residence, history of prior radial cannulation, diabetes mellitus, and hypertension, were documented in a structured proforma.

Radial artery puncture was performed 1–2 cm proximal to the radial styloid process using standard sterile technique. All patients received intra-arterial vasodilators—either 200 µg nitroglycerin or 2.5 mg verapamil—alongside intravenous unfractionated heparin at a dose of 50–100 IU/kg, as per operator discretion. Sheath and catheter sizes were likewise selected according to operator preference; however, no slender or sheathless catheters were utilized. Hemostasis was achieved using a radial compression device or manual compression, with an aim to maintain patent hemostasis in all cases. RAO assessment was performed at 24 hours post-procedure through a combination of clinical and diagnostic measures. Radial artery palpation was followed by the Reverse Barbeau Test (RBT), in which a pulse oximeter was placed on the thumb and the ulnar artery was manually compressed to observe waveform changes. A type D RBT pattern, in conjunction with complete loss of antegrade blood flow on color Doppler ultrasound, was considered diagnostic for loss of radial pulse. All procedural and post-procedural data were recorded in a predesigned proforma (11,12). Data analysis was conducted using SPSS version 26. Categorical variables, such as gender and presence of diabetes mellitus, were expressed as frequencies and percentages, while continuous variables, including age and BMI, were reported as mean ± standard deviation (SD) or median with interquartile range (IQR), depending on the results of normality testing via the Shapiro–Wilk test. RAO was stratified according to relevant demographic and clinical factors, and post-stratification analysis was performed using the Chi-square test or Fisher's exact test, as appropriate. A p-value ≤ 0.05 was considered statistically significant.

RESULTS

The study included 113 patients undergoing transradial coronary catheterization. The mean age of the participants was 56.3 ± 8.9 years, with a predominance of males (60.2%, n = 68) compared to females (39.8%, n = 45). The mean body mass index (BMI) was 27.1 ± 3.4 kg/m², indicating a trend toward overweight or obesity. Hypertension was present in 62 patients (54.9%) and diabetes mellitus in 48 patients (42.5%). Seventeen patients (15.0%) had a documented history of previous radial artery cannulation. Loss of radial pulse at 24 hours post-procedure was observed in 13 patients (11.5%). Diagnosis was confirmed by the presence of a type D pattern on the Reverse Barbeau Test in conjunction with complete loss of antegrade flow on Doppler ultrasound. Among patients with RAO, 10 (76.9%) had a BMI greater than 27 kg/m², 8 (61.5%) were diabetic, and 5 (38.5%) had a history of prior radial cannulation. Stratification analysis demonstrated a slightly higher proportion of RAO in males compared to females (69.2% vs. 30.8%), although the difference did not reach statistical significance ($p = 0.43$). No statistically significant associations were found between RAO and age or hypertension. In contrast, statistically significant associations were observed with diabetes mellitus ($p = 0.044$), BMI > 27 kg/m² ($p = 0.038$), and previous radial artery cannulation ($p = 0.031$). These results highlight that while the overall incidence of RAO remained in line with previously reported figures, certain patient-related factors—particularly metabolic and procedural history—were associated with higher risk. When expressed with 95% confidence intervals, the incidence of loss of radial pulse in this cohort was 11.5% (95% CI: 5.6%–17.4%). This range indicates that while the point estimate is in close alignment with prior literature, the true incidence within the underlying population may plausibly vary between approximately one in eighteen and one in six patients. Incorporating this interval estimate strengthens the precision and interpretability of the findings by accounting for sampling variability.

Table 1: Demographic Characteristics of Study Participants

Variable	Value
Mean Age (years)	56.3 ± 8.9
Gender	
Male	68 (60.2%)
Female	45 (39.8%)
Mean BMI (kg/m²)	27.1 ± 3.4
Hypertension	62 (54.9%)
Diabetes Mellitus	48 (42.5%)
Previous Radial Cannulation	17 (15.0%)

Table 2: Incidence of Radial Artery Occlusion (RAO)

RAO Status	n (%)	95% CI for %
Present	13 (11.5%)	5.6–17.4
Absent	100 (88.5%)	—

Table 3: RAO Frequency by Significant Risk Factors

Risk Factor	RAO Present (n=13)	p-value
BMI > 27 kg/m²	10 (76.9%)	0.038
Diabetes Mellitus	8 (61.5%)	0.044
Previous Radial Cannulation	5 (38.5%)	0.031

Table 4: RAO Frequency by Non-Significant Factors

Factor	RAO Present (%)	p-value
Male Gender	69.2%	0.43
Female Gender	30.8%	0.43
Age	—	NS
Hypertension	—	NS

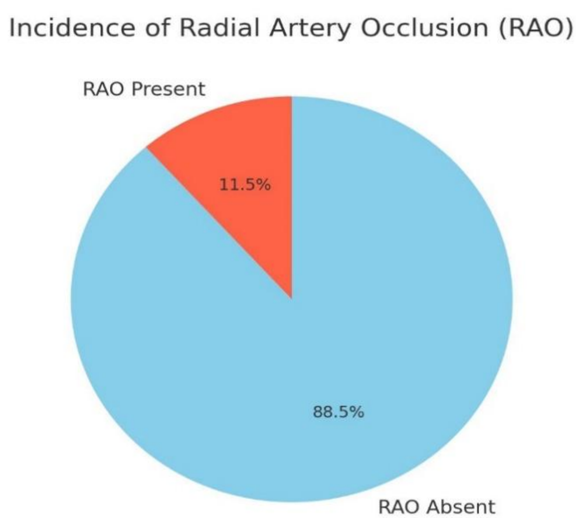

Figure 1 Incidence of Radial Artery Occlusion (RAO)

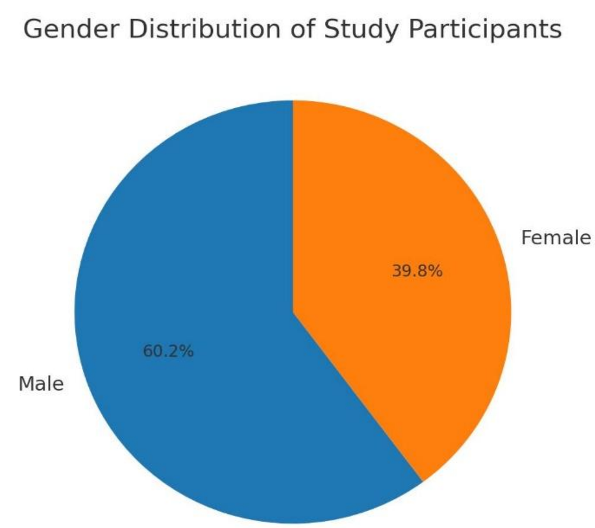

Figure 2 Gender Distribution of Study Participants

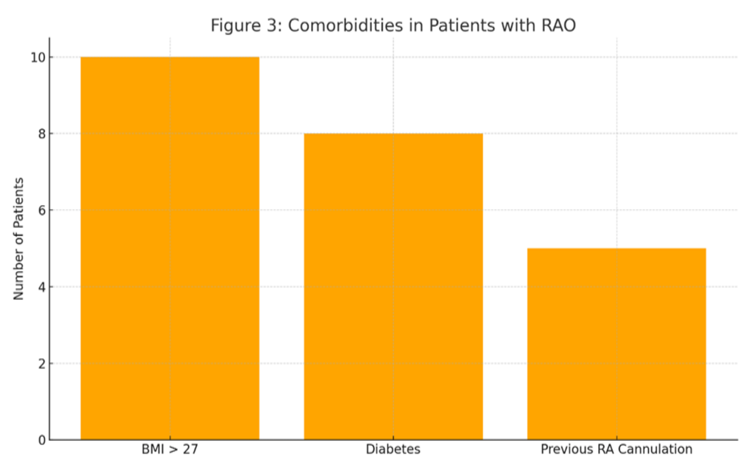

Figure 3 Comorbidities in Patients with RAO

DISCUSSION

The present study demonstrated that the frequency of radial artery occlusion (RAO), identified as loss of radial pulse 24 hours after transradial coronary catheterization, was 11.5%, closely aligning with international reports where comparable rates have been documented (12). This reinforces the recognition of RAO as a common, procedure-related complication of the transradial approach (TRA), which, despite often being clinically silent due to the dual arterial supply of the hand, can have important implications for future vascular access. Its occurrence may limit the reuse of the radial artery for subsequent coronary interventions, dialysis access, or as a conduit for coronary artery bypass grafting (13-15). The findings confirmed several patient-related risk factors for RAO. Diabetes mellitus and elevated body mass index (BMI > 27 kg/m²) emerged as statistically significant predictors, consistent with previous evidence suggesting that metabolic syndrome and obesity contribute to endothelial dysfunction, impaired vascular reactivity, and increased susceptibility to thrombotic occlusion (16,17). The influence of obesity may also be related to technical factors, such as reduced effectiveness of radial compression devices in achieving patent hemostasis. A history of previous radial artery cannulation was also significantly associated with RAO, supporting prior observations that repeated access can lead to cumulative endothelial injury, intimal hyperplasia, and fibrotic changes that compromise vessel patency (18). Gender did not exhibit a statistically significant association with RAO, despite a numerically higher occurrence in males, which is in line with literature suggesting that anatomical factors, such as arterial diameter and the sheath-to-artery ratio, are more influential determinants than sex alone (19). Similarly, hypertension, although a recognized cardiovascular risk factor, showed no significant correlation in this cohort. This may reflect effective intra-procedural blood pressure control or the predominance of other more direct vascular risk modifiers such as diabetes and obesity.

The observed incidence supports the continued preference for TRA over transfemoral access, given its lower overall complication profile and patient comfort advantages. Nonetheless, the results highlight the need for targeted preventive strategies, particularly in high-risk groups. These may include the consistent use of adequate anticoagulation, adoption of patent hemostasis techniques, minimization of sheath size relative to artery diameter, and routine post-procedural patency checks using the Reverse Barbeau Test or Doppler ultrasound (20,21). This study offers several strengths, including a well-defined methodology, objective confirmation of RAO with both functional and imaging assessments, and a setting reflective of routine tertiary care practice. However, certain limitations must be acknowledged. The single-center design and relatively small sample size may limit generalizability, while the short follow-up period of only 24 hours could underestimate RAO incidence by missing delayed or transient occlusions. Procedural variability—such as differences in sheath size, vasodilator use, and hemostasis technique—was not standardized and may have influenced outcomes. Additionally, details such as sheath-to-artery ratio, radial artery diameter, and use of ultrasound guidance for access were not recorded, and the non-probability consecutive sampling approach could introduce selection bias. Future research should focus on larger, multicenter studies with longer follow-up to assess the persistence of RAO and the efficacy of various preventive measures. Incorporating standardized procedural protocols, evaluating sheath-to-artery ratios, and including ultrasound-guided access could further elucidate modifiable factors. Such work would not only improve patient outcomes but also preserve radial artery integrity for future cardiovascular interventions.

CONCLUSION

This study concludes that loss of radial pulse following transradial coronary catheterization remains a clinically relevant complication, with certain patient-related factors—particularly diabetes mellitus, increased body mass index, and previous radial artery cannulation—contributing to heightened risk. While the transradial approach continues to offer clear advantages over femoral access in terms of safety and patient comfort, its optimal use depends on careful patient selection, meticulous procedural technique, and adoption of preventive strategies such as patent hemostasis and appropriate anticoagulation. Incorporating routine post-procedural vascular assessments using simple, non-invasive methods like the Reverse Barbeau Test and Doppler ultrasound can enable early detection and timely intervention, thereby preserving radial artery integrity for future cardiovascular procedures.

AUTHOR CONTRIBUTION

Author	Contribution
Sher Ali Khan*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Jabar Ali	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Atif Kamal	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Saddam Hussain	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Syed Muhammad Nayab Ali	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published

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