

Efficacy of Xylocaine and Nitrate Combination in Preventing Radial Artery Spasm and Pain during Transradial Coronary Interventions

Abdul Waris, Naveed Danish, Muhammad Niaz Khan

Department of Cardiology, MTI-Hayatabad Medical Complex, Peshawar

ABSTRACT

Objective: To compare the efficacy of Xylocaine combined with nitrate versus nitrate and placebo in preventing radial artery spasm (RAS) and reducing pain during transradial coronary interventions.

Methodology: This study was conducted at Hayatabad Medical Complex, Peshawar, from July to December 2024. A total of 60 patients undergoing transradial coronary procedures were included. Patients were assigned to one of two treatment groups based on clinical considerations: 30 received Xylocaine and nitrate, while 30 received nitrate and placebo. Both patients and interventional cardiologists were blinded to treatment allocation. Radial artery spasm was assessed using a radial spasm score, and pain was measured using the Visual Analog Scale (VAS). Statistical analysis was performed using t-tests and chi-square tests, with significance set at $p < 0.05$.

Results: The Xylocaine and nitrate group had a significantly lower RAS rate (13.3%) compared to the nitrate and placebo group (36.7%) ($p = 0.04$). Pain scores were also significantly lower in the Xylocaine and nitrate group (2.3 ± 1.2) than in the placebo group (4.1 ± 1.6) ($p = 0.01$). Procedural duration and nitrate doses were similar between groups.

Conclusion: The combination of Xylocaine and nitrate significantly reduces radial artery spasm and procedural pain compared to nitrate and placebo. This double-blind quasi-experimental study supports its clinical utility in improving patient outcomes during transradial coronary interventions.

Keywords: Coronary Interventions, Nitrate, Pain Reduction, Radial Artery Spasm, Xylocaine

Authors' Contribution:

^{1,2}Conception; Literature research; manuscript design and drafting; ^{2,3}Critical analysis and manuscript review; ^{1,3}Data analysis; Manuscript Editing.

Correspondence:

Muhammad Niaz Khan
Email: roshni.mnk@gmail.com

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Introduction

The radial artery approach for coronary interventions has gained widespread acceptance due to its reduced complication rates and enhanced patient comfort compared to femoral access.¹ However, challenges such as radial artery spasm (RAS) remain a critical limitation, necessitating innovative solutions to mitigate patient discomfort

and improve procedural outcomes.² This study, conducted at the Department of Cardiology, Hayatabad Medical Complex, Peshawar, evaluated the effectiveness of xylocaine and nitrate combination versus nitrate and placebo in addressing these challenges during radial artery access for coronary interventions. The use of topical gels combining lidocaine, nitroglycerin, and other vasodilators has been shown to significantly reduce

RAS and improve procedural success rates. A study demonstrated that a combined gel of lidocaine, verapamil, and nitroglycerin increased radial artery diameter and decreased pain intensity during transradial angioplasty.³ In Pakistan, coronary interventions have seen significant advancements in recent years. Research from the region highlights the growing adoption of radial access and the importance of mitigating complications such as RAS.⁴ Topical applications such as nitroglycerin patches have also proven beneficial in reducing RAS and radial artery occlusion.⁵ Randomized controlled trials have consistently shown that combining vasodilators like nitrates with local anesthetics such as lidocaine reduces procedural pain and enhances the success of radial access.⁶ Notably, nitrates improve vasodilation, reducing the likelihood of spasm and arterial occlusion.⁷ The effectiveness of radial artery access in coronary intervention is contingent upon various aspects, notably the mitigation of radial arterial spasm, which may impede procedural success and patient outcomes.⁸ Radial artery spasm, though transient in nature, poses challenges during catheter manipulation and can lead to procedural delays and discomfort for patients. Therefore, strategies to prevent radial artery spasm are of paramount importance in optimizing the success of coronary interventions through radial access.⁹ Several studies have compared different radial artery access approaches for coronary interventions. A study by Tariq et al demonstrated that distal radial artery access is associated with poorer cannulation success rates compared to forearm radial artery access. Additionally, hematomas were more prevalent with forearm radial artery access.¹⁰ Several meta-analyses and systematic reviews have synthesized data from multiple studies to provide insights into the comparative effectiveness of radial artery access approaches. Studies such as Feghaly et al. and Prasad et al. reported that distal radial artery access is associated with reduced incidence of radial

artery occlusion and certain procedural complications, thus suggesting potential benefits for coronary interventions.^{11,12} Prospective trials have provided valuable insights into the efficacy and safety of traditional and distal radial artery access.¹³ While both approaches were found to have similar efficacy and safety profiles, distal radial access may entail longer puncture times due to the smaller artery diameter.¹³ Local studies, such as one conducted in Hayatabad Medical Complex, underscore the need for tailored approaches to coronary intervention in Pakistan's unique healthcare setting. This includes adapting international best practices to regional contexts.⁴ Despite extensive research on radial access, comparative studies evaluating combinations of xylocaine and nitrates versus placebo remain limited. This study aims to fill this gap by providing robust evidence on their efficacy in reducing RAS and improving patient outcomes.

This study was designed to compare the efficacy of Xylocaine and nitrate versus nitrate and placebo in preventing radial artery spasm and improving procedural outcomes during coronary interventions.

Methodology

This double-blind quasi-experimental study was conducted in the Department of Cardiology, Hayatabad Medical Complex, Peshawar, over a six-month period from July 2024 to December 2024.

A total of 60 adult patients were included in the study. The sample size was calculated using the WHO formula, based on previous research demonstrating a 40% reduction in radial artery spasm with topical nitroglycerin and lidocaine. Patients were divided into two groups: 30 received a combination of Xylocaine and nitrate, and 30 received nitrate and placebo.

Inclusion Criteria:

- Adult patients aged 18–75 years undergoing elective or urgent transradial coronary intervention.

- Stable hemodynamics (heart rate 60–100 bpm; normal blood pressure).
- Written informed consent obtained.
- Diagnosed with stable angina, NSTEMI, or atherosclerotic coronary artery disease.

Exclusion Criteria:

- Known allergy to nitrates or lidocaine.
- Severe renal (eGFR <30 mL/min/1.73 m²) or liver dysfunction (Child-Pugh B or higher).
- Pregnant or breastfeeding women or those not using contraception.
- Severe arrhythmias, uncontrolled hypertension (>180/110 mmHg), or hypotension (<90 mmHg systolic).

Group Allocation and Blinding:

Participants were non-randomly assigned to either the intervention or control group based on clinical considerations and medication availability. To reduce bias, both the patients and the interventional cardiologists were blinded to group assignment using identical packaging for the study medications.

- **Group 1 (Intervention):** Xylocaine + Nitrate
- **Group 2 (Control):** Nitrate + Placebo

Data Collection:

Baseline demographic and clinical data were recorded. Radial artery diameter was measured via ultrasound before and after application of study medication. Radial artery spasm (RAS) was assessed using a standardized radial spasm score, and pain was evaluated using the Visual Analog Scale (VAS).

Definitions:

- **Radial Artery Spasm (RAS):** Resistance during catheter advancement/withdrawal with patient discomfort.
- **Pain Score:** Measured on a VAS (0 = no pain, 10 = worst pain).

Statistical Analysis:

Continuous variables were expressed as mean ± SD; categorical variables as percentages. Group comparisons were performed using independent-sample t-tests (continuous data) and chi-square tests (categorical data). A p-value < 0.05 was considered statistically significant.

Ethical approval was obtained from the Research and Ethics Committee of Hayatabad Medical Complex, Peshawar (Ref#1125, dated 2nd February 2024). All participants gave written informed consent. The study was conducted in accordance with the Declaration of Helsinki.

Results

The study aimed to compare the efficacy of Xylocaine and Nitrate versus Nitrate and Placebo in preventing radial artery spasm during coronary interventions. A total of 60 patients were included in the study, with 30 patients receiving Xylocaine and Nitrate (Group 1) and 30 patients receiving Nitrate and Placebo (Group 2). Participants were assigned to one of the two treatment groups based on clinical indications or pre-existing conditions.

Table I. Baseline Characteristics of Study Participants (n=60)

Characteristic	Xylocaine and Nitrate (n=30)	Nitrate and Placebo (n=30)	P-value
Mean Age (Years)	58.5 ± 6.2	57.8 ± 5.9	0.61
Male: Female Ratio	18:12	17:13	0.75
Hypertension	80%	76%	0.79
Diabetes	55%	58%	0.83

Table II. Procedural details comparison between the groups (n=60)

Parameter	Xylocaine/ Nitrate (n=30)	Nitrate/ Placebo (n=30)	Total
Mean Procedure Duration Min	45.2 ± 10.4	46.1 ± 9.7	45.7 ± 10.1
Mean Xylocaine Dose	100.4 ± 20.5	0 (Placebo)	50.2 ± 20.5
Mean Nitrate Dose	10.3 ± 2.1	10.5 ± 2.3	10.4 ± 2.2

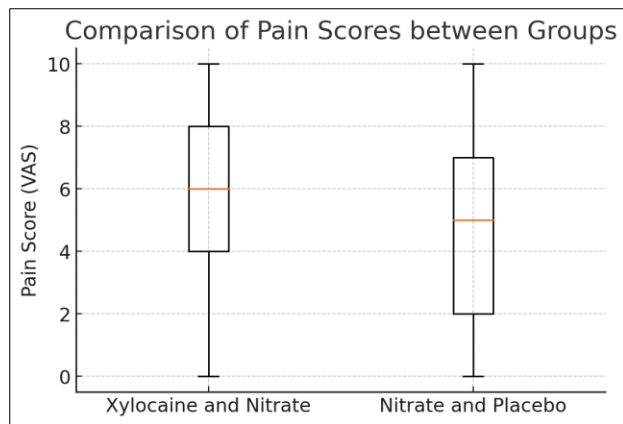


Figure 1: Comparison of radial artery spasm rate between groups

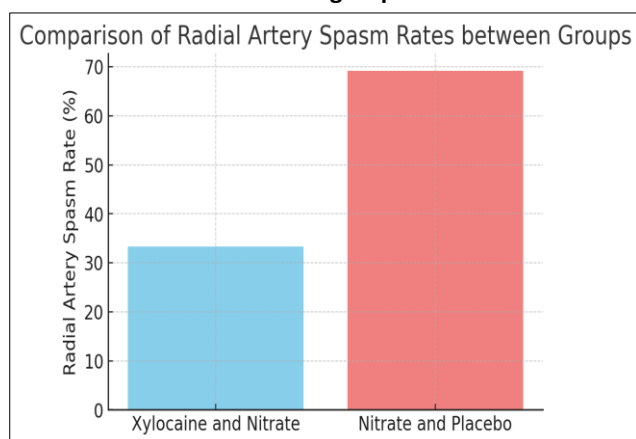


Figure 2: Comparison of Pain Scores (measured on VAS) between groups

Table III. Radial artery spasm rate and pain score comparison (n=60)			
	Group 1	Group 2	p-value
Radial Artery Spasm	13.3%	36.7%	0.04
Mean Pain Score (VAS)	2.3 ± 1.2	4.1 ± 1.6	0.01

Demographic and Baseline Characteristics

The baseline characteristics of both groups are summarized in Table 1. No significant differences were observed between the two groups in terms of age (58.5 ± 6.2 vs 57.8 ± 5.9 years, $p = 0.61$), sex distribution (male-to-female ratio of 18:12 vs 17:13, $p = 0.75$), hypertension (80% vs 76%, $p = 0.79$), or diabetes (55% vs 58%, $p = 0.83$). These findings confirm that both groups were comparable at

baseline, which ensures a valid comparison for the study.

Procedural details and interpretation

Table II summarizes the procedural details for both groups. The mean procedure duration was 45.2 minutes for the Xylocaine and Nitrate group and 46.1 minutes for the Nitrate and Placebo group, showing no significant difference. The mean Xylocaine dose was 100.4 mg in the Xylocaine and Nitrate group, while the Nitrate and Placebo group received 0 mg, reflecting the treatment design. The mean nitrate dose was 10.3 mg for the Xylocaine and Nitrate group and 10.5 mg for the Nitrate and Placebo group, indicating similar nitrate administration across both groups.

Radial Artery Spasm Rate

One of the primary outcomes of the study was the incidence of Radial Artery Spasm (RAS) during the intervention. As shown in Figure 1, the rate of RAS was significantly lower in the Xylocaine and Nitrate group (Group 1) compared to the Nitrate and Placebo group (Group 2). Group 1 had a 13.3% incidence of RAS, while Group 2 had a 36.7% incidence, with a statistically significant difference ($p = 0.04$).

Pain Score (VAS)

The second major outcome was the assessment of patient pain during the procedure, measured using the Visual Analog Scale (VAS). As shown in Figure 2, the pain score was significantly lower in the Xylocaine and Nitrate group (Group 1) compared to the Nitrate and Placebo group (Group 2). Group 1 had a mean pain score of 2.3 ± 1.2 , whereas Group 2 had a significantly higher mean pain score of 4.1 ± 1.6 , with a statistically significant difference ($p = 0.01$).

Statistical Analysis

Table 3 shows the rates of RAS and pain scores for both groups. The Xylocaine and Nitrate group had a significantly lower RAS rate (13.3%) compared to the Nitrate and Placebo group (36.7%), with a p-value of 0.04. The pain score in the Xylocaine and Nitrate group was significantly lower (2.3 ± 1.2) than in the

Nitrate and Placebo group (4.1 ± 1.6), with a p-value of 0.01. These results suggest that the combination of Xylocaine and Nitrate is effective in reducing radial artery spasm and pain during coronary interventions.

Discussion

This study demonstrated that the combination of Xylocaine and nitrate was associated with a significantly reduced incidence of radial artery spasm (RAS) and patient-reported pain during transradial coronary interventions compared to nitrate and placebo. The RAS rate was 13.3% in the Xylocaine and nitrate group, whereas it was 36.7% in the nitrate and placebo group ($p = 0.04$). Similarly, the pain score was significantly lower in the Xylocaine and nitrate group (2.3 ± 1.2) compared to the nitrate and placebo group (4.1 ± 1.6 , $p = 0.01$). These findings provide compelling evidence that the combination of Xylocaine and nitrate may offer superior procedural outcomes in mitigating RAS and reducing patient discomfort, as observed in our cohort. Radial artery spasm is a well-documented challenge during transradial coronary procedures, with prior studies reporting its prevalence to be as high as 20-30% in untreated cases.¹ Studies from other countries, such as those by Sevda et al., have investigated the use of topical agents like lidocaine and nitrate in combination and reported similar benefits, including a reduction in RAS and procedural pain.³ However, these studies were conducted in controlled settings outside Pakistan and often involved variations in medication dosages and procedural techniques. In Pakistan, research on RAS and pain management during radial coronary interventions remains scarce. Some studies have explored vasodilators like nitrates, but they lack comprehensive evaluations of combinations such as xylocaine and nitrate.¹⁴ While the use of radial artery access is increasingly common in the country, the local literature lacks randomized controlled trials directly comparing the efficacy of Xylocaine and

nitrate versus standard treatments. This study addresses a significant gap, providing context-specific data that can inform clinical practice in Pakistan.

Dworeck et al. emphasized that radial artery access is associated with lower mortality and fewer complications compared to femoral access, reinforcing the importance of effective interventions, such as xylocaine and nitrate, in minimizing complications like radial artery spasm.² Tariq et al. compared distal radial artery access to forearm radial artery access, highlighting reduced complications and procedural failures with effective vasodilation strategies like those used in our study with xylocaine and nitrate.¹⁰ These studies provide further evidence that improving radial artery dilatation can reduce procedural difficulties.

Similarly, Zakariya Elattar et al. demonstrated that local anesthetics and vasodilators significantly reduce complications in radial artery access during coronary angiography, which aligns with our findings that combining xylocaine and nitrate effectively mitigates radial artery spasm and improves procedural outcomes.⁴ Furthermore, Rigattieri et al. (2021) discussed how glycoprotein inhibitors can enhance the safety of radial artery access during coronary procedures, supporting the notion that reducing radial artery spasm, as in our study with xylocaine and nitrate, is crucial for improving procedural success and patient comfort.⁶

Several international studies align with our findings, underscoring the efficacy of Xylocaine and nitrate in mitigating RAS and pain. For instance, Gopalakrishnan et al. highlighted the effectiveness of topical nitroglycerin in reducing access site failures and procedural discomfort.⁷ Similarly, the combination of lidocaine and nitrate has been reported to enhance radial artery dilation and alleviate pain, as demonstrated by Uslu et al.¹⁵ These studies reinforce the applicability of the findings in various clinical settings. Local studies have predominantly focused on standalone

vasodilators or calcium channel blockers, with limited exploration of combined therapies.¹⁴ This underscores the novelty of our approach and its potential to establish a new standard for patient care in transradial interventions within the country. The statistically significant reduction in RAS and pain observed in the xylocaine and nitrate group highlights the synergistic effects of these agents. Xylocaine's anesthetic properties likely contributed to lower pain scores, while nitrate's vasodilatory effects reduced RAS by increasing radial artery diameter. These results are consistent with the underlying pharmacological mechanisms, as previously documented in international studies.³

Conclusion

This study demonstrated that xylocaine combined with nitrate significantly reduces radial artery spasm and pain during coronary interventions, outperforming the nitrate and placebo group. These findings support the use of xylocaine and nitrate as an effective approach to improving procedural outcomes and minimizing discomfort, offering valuable insights for enhancing patient care in coronary procedures.

Study Limitations and Future Directions: This study was conducted at a single center, potentially limiting the generalizability of its findings. Additionally, the relatively small sample size may restrict the ability to detect subtle differences in secondary outcomes. In order to verify these findings, future research should investigate multicentre designs with larger sample sizes. Moreover, exploring alternative combinations of vasodilators and anaesthetics or varying dosages could provide deeper insights into optimizing treatment protocols. Further studies with larger sample sizes and multi-center trials are suggested to confirm these results. Additionally, research into the optimal dosing and timing of xylocaine and nitrate is recommended, and long-term follow-up studies to assess the impact on post-procedural complications and patient outcomes is recommended

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