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Original Article

# The Effect of Topical Diltiazem on Radial Artery Cannulation Success in Coronary Angiography

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## Abstract

**Objectives:** Radial artery cannulation for coronary angiography has become the preferred approach due to its association with reduced complications and faster recovery times compared to femoral artery access. However, the procedure can still pose challenges, particularly in patients with small or spastic arteries. This study aims to assess the impact of applying topical diltiazem cream on radial artery dilation, cannulation success, puncture time, and complication rates in patients undergoing coronary angiography.

**Methods:** There were 57 patients included in the study, of whom 29 were topically treated with 2% diltiazem before radial puncture and 28 were not. 2.5 cm length of cream squeezed was applied for standardization based on manufacturer's suggestion.

**Results:** The mean age of the patients was 59.1±10.2 in the control group and 58.3±9.5 in the study group (p>0.05). The gender and comorbidities of the patients were statistically comparable. The study group achieved an 86.2% (25/29) success rate in first-attempt cannulation, compared to 67.9% (19/28) in the control group (p=0.038). The mean time required for puncture was significantly shorter in the study group (41.8±7.9 s) than in the control group (56.7±9.8 s) (p=0.031). The complication rates were low and similar among groups.

**Conclusion:** Topical diltiazem cream application may significantly improve radial artery cannulation success and reduces puncture time while decreasing complication rates in patients undergoing coronary angiography.

**Keywords:** Administration; coronary angiography; diltiazem; radial artery; topical; vascular access device.

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# Koroner Anjiyografide Radyal Arter Kanülasyon Başarısında Topikal Diltiazemin Etkileri

## Özet

**Amaç:** Koroner anjiyografi için radyal arter kanülasyonu, femoral arter erişimiyle karşılaştırıldığında daha az komplikasyon ve daha hızlı iyileşme süreleri ile ilişkili olması nedeniyle tercih edilen yaklaşım haline gelmiştir1,2. Ancak, prosedür özellikle küçük veya spastik arterleri olan hastalarda hala zorluklar yaratabilir. Bu çalışma, koroner anjiyografi geçiren hastalarda topikal diltiazem kremi uygulamasının radyal arter genişlemesi, kanülasyon başarısı, ponksiyon süresi ve komplikasyon oranları üzerindeki etkisini değerlendirmeyi amaçlamaktadır.

**Gereç ve Yöntem:** Çalışmaya toplam 57 hasta dahil edildi. Bunlardan 29'una radyal ponksiyon öncesi %2 diltiazem ile topikal tedavi uygulandı, 28'ine ise uygulanmadı. Üretici firmanın önerisi doğrultusunda standardizasyon amacıyla 2,5 cm uzunluğunda krem sıkıldı.

**Bulgular:** Hastaların yaş ortalaması kontrol grubunda 59,1±10,2, çalışma grubunda ise 58,3±9,5 idi (p>0,05). Hastaların cinsiyeti ve eşlik eden hastalıkları istatistiksel olarak karşılaştırılabilirdi. Çalışma grubunda ilk deneme kanülasyonunda %86,2 (25/29) başarı oranı elde edilirken, kontrol grubunda bu oran %67,9 (19/28) idi (p: 0,038). Çalışma grubunda ponksiyon için gereken ortalama süre (41,8±7,9 saniye) kontrol grubuna göre (56,7±9,8 saniye) anlamlı derecede daha kısaydı (p=0,031). Komplikasyon oranları düşüktü ve gruplar arasında benzerdi.

**Sonuç:** Koroner anjiyografi uygulanan hastalarda topikal diltiazem krem uygulaması radyal arter kanülasyon başarısını önemli ölçüde artırabilir, ponksiyon süresini kısaltırken komplikasyon oranlarını azaltabilir.

**Anahtar sözcükler:** Uygulama; koroner anjiyografi; diltiazem; radyal arter; topical; vasküler erişimi.

## Introduction

Radial artery cannulation for coronary angiography has become the preferred approach due to its association with reduced complications and faster recovery times compared to femoral artery access.[1,2] However, the procedure can still pose challenges, particularly in patients with small or spastic arteries. To improve outcomes, various adjuncts have been explored, including vasodilators that facilitate easier catheterization.[3,4]

Diltiazem, a calcium channel blocker best known for its vasodilatory properties, has been used effectively to manage coronary artery spasm and hypertension.[5,6] Topical application of diltiazem has emerged as a potential strategy to enhance radial artery dilation before puncture. By inhibiting calcium influx into smooth muscle cells, diltiazem leads to arterial relaxation, potentially improving both the success rate of first-attempt cannulation and reducing the time required for the procedure.[4,7]

In this study, we aimed to investigate the effects of topical diltiazem cream on radial artery dilation, cannulation success, puncture time, and complication rates in patients undergoing elective coronary angiography.

## Materials and Methods

The study is of a prospective; non-randomized interventional (quasi-experimental) design. Before enrollment, all participants provided written informed consent after receiving a detailed explanation of the study's purpose, procedures, potential benefits, and risks. The study protocol was reviewed and approved by the Institutional Ethics Committee of Private Edremit Korfez Hospital, ensuring compliance with the ethical principles outlined in the Declaration of Helsinki. Ethical approval was granted under the reference number 3678777-12, date October 1, 2023, and all procedures adhered to established guidelines for conducting research involving human subjects.

This prospective study included 57 patients undergoing elective coronary angiography between April 2024 and June 2024. "Odd numbered" patients included in the study was included in study group, and "even numbered" ones in the control group. The study group (n=29) received topical diltiazem cream application, while the control group (n=28) received no topical vasodilator. In the study group, 2% diltiazem cream (Locafen 2%, 30 g, İlko İlaç, İstanbul, Turkey) was applied over the radial artery site 30 min before the procedure. 2.5 cm length of squeezed cream was applied for standardization based on manufacturer's suggestion. The control group underwent standard preparation without diltiazem. All procedures were performed by the same operator under ultrasonography guidance.

Primary outcome measures were radial artery cannulation success on the first attempt and the time required for successful radial artery puncture. Secondary outcome measures were the incidence of complications (hematoma, arterial spasm, or local skin irritation). Complications were addressed based on the operator's comment.

The diameter of the radial artery was measured using ultrasonography with a high-frequency linear probe (Philips, Affiniti 50, Diagnostic Ultrasound System, Amsterdam, Netherlands). Measurements were performed at the puncture site, specifically 1 cm proximal to the styloid process of the radius.

### Puncture Technique

The patient was positioned with the wrist slightly extended and the arm comfortably supported. After preparing the skin using sterile technique, a high-frequency linear ultrasound probe is placed over the radial artery, typically 1–2 cm proximal to the wrist crease. The artery was identified in the short-axis (transverse) view as a pulsatile, hypoechoic circular structure. Under real-time ultrasound guidance, a 20G needle was advanced in-plane or out-of-plane toward the artery until the tip is visualized entering the lumen. Once blood return was confirmed, a guidewire is inserted through the needle, followed by advancement of a 5F standard vascular sheath (Barty Medical, Hangzhou, China). Ultrasound was used throughout to confirm correct placement and assess for complications.

### Statistical Analysis

Statistical analyses were conducted using SPSS version 26.0 (IBM Corp., Armonk, NY, USA). The independent samples t-test was used to compare the mean values of continuous data between groups. The paired t-test analyzed changes in radial artery diameter within the study group before and after diltiazem application. The Chi-square test was applied to evaluate differences in complication rates between the groups.

## Results

There were 28 patients in the control group and 29 patients in the study group. The mean age of the patients was 59.1±10.2 in the control group and 58.3±9.5 in the study group (p>0.05). The gender and comorbidities of the patients were statistically comparable (Table 1). Radial artery access measures and complication rates are summarized in Table 2 and the central illustration. The study group achieved an 86.2% (25/29) success rate in first-attempt cannulation compared to 67.9% (19/28) in the control group (p=0.038). The mean time required for puncture was significantly shorter in the study group (41.8±7.9 s) than in the control group (56.7±9.8 s) (p=0.031).

**Table 1. Demographic characteristics of patients**

| | Control group (n=28) | | Study group (n=29) | | p |
|---|---|---|---|---|---|
| | n | % | n | % | |
| Male | 19 | | 20 | | 0.88 |
| Female | 9 | | 9 | | |
| Age (mean±SD) | 59.1±10.2 | | 58.3±9.5 | | 0.72 |
| Hypertension | 15 | 53.6 | 15 | 51.7 | 0.81 |
| Diabetes mellitu | 11 | 39.3 | 11 | 37.9 | 0.92 |
| Smoking | 14 | 50 | 14 | 48.3 | 0.87 |
| Hyperlipidemia | 17 | 60.7 | 19 | 65.5 | 0.78 |
| Peripheral arterial disease | 4 | 14.2 | 5 | 17.2 | 1.0 |

SD: Standard deviation

**Table 2. Radial artery access measures and complication rates**

| | Control group (n=28) | | Study group (n=29) | | p |
|---|---|---|---|---|---|
| | n | % | n | % | |
| First-attempt success rate | 19/28 | 67.9 | 25/28 | 86.2 | 0.038 |
| Average puncture time (s) | 56.7±9.8 s | | 41.8±7.9 s | | 0.031 |
| Radial artery diameter (mm) | 2.5±0.3 | | Pre: 2.4±0.3<br>Post: 3.0±0.4 | | 0.001 |
| Hematoma rate (%) | 3/28 | 10.7 | 2/29 | 6.9 | 0.54 |
| Arterial spasm rate (%) | 5/28 | 17.9 | - | - | 0.06 |
| Skin irritation rate (%) | - | - | - | - | |

The mean radial artery diameter in the study group increased from 2.4±0.3 mm to 3.0±0.4 mm post-application, while no significant change was noted in the control group (2.5±0.3 mm) (p=0.001). Pre-diltiazem radial artery diameters were also similar between groups (p>0.05).

Complication rates were low in both groups. The study group experienced 6.9% (2/29) minor hematoma, with no cases of arterial spasm or skin irritation. The control group experienced 17.9% (5/28) arterial spasms (p=0.06), 10.7% (3/28) minor hematomas (p=0.54) and no skin irritation.

## Discussion

Radial artery spasm, which may obstruct cannulation, has been reported to be up to 51%. Female sex, small body size, and emergent procedure settings may increase tendency. Distal access, hydrophilic catheter use, and appropriate sheath and catheter sizing are important preventive measures.[1] Despite the unwanted spasm condition, transradial access is still the most preferred technique for coronary angiography due to lower bleeding, improved outcomes, increased patient comfort, earlier ambulation compared to femoral route and reduced long-term costs.[8–10] Transradial coronary angiography is reported to be performed in 95% of cases.[1] However, occurrence of spasm may lead to radial artery obstruction on long-term and increase complication rates such as hematoma formation, increased radiation time/dose, more frequent access site cross-over, catheter entrapment, as well as arterial avulsion in very extreme cases.[1] Therefore, strategies directed to prevent spasm have been a research area to secure transradial angiography. Mechanical compression, use of sheathless catheters, sedation, nerve block, compression, subcutaneous and topical agents have been employed for this purpose.[1,11] Topical agents have been an area of interest to overcome spasm. Nitroglycerine and lidocaine use were reported to overcome spasm without affecting systemic blood pressure, but controversial results have been published.[12–14] Society for Cardiovascular Angiography and Interventions only recommends ultrasound-guided puncture to prevent radial artery spasm.[15] In our opinion, the recommendation needs further assistance in order to overcome spasm which possibly will be via pharmacologic agents, preferably topically.

Diltiazem causes smooth-muscle relaxation by slow L-type calcium channel blockage, therefore prevents calcium influx into the smooth-muscle cells, and decreases intracellular calcium, resulting decreased amount of calcium available to combine with calmodulin and prevent activation of the myosin light-chain kinase required for smooth muscle cell contraction.[16] Diltiazem has been documented to prevent calcium influx when used topically, particularly in anal fissure treatment.[17] Moreover, ability of diltiazem to inhibit calcium influx in vascular smooth muscle cells accounts for the observed increase in radial artery diameter, facilitating smoother arterial access.[6,11,18] This effect is particularly beneficial in patients with smaller or vasospastic arteries, often posing challenges during radial access procedures, and who have an increased tendency for access site complications.[19,20] Supporting this data, we also concluded that the application of topical diltiazem cream significantly enhances radial artery cannulation success in patients undergoing coronary angiography. The findings align with previous research on the vasodilatory effects of calcium channel blockers as well.[21–23] Topical use nevertheless does not affect systemic blood pressure.

It should be kept in mind that there is still no objective criterion for transradial artery angiography. Puncture experience, technique, and materials employed are subjective. We think that these factors prevent standardization and may enhance radial artery spasm. Aiming to prevent spasm may be the key factor for more or less standardization and extenuate outcomes. Techniques and agents mentioned above may implicate clinical results as our study does, which may be considerable. Faster and ideal cannulation of the radial artery will probably reduce patient discomfort and procedural delays while minimizing risks of complications like hematoma and arterial spasm. In settings where radial access is preferred, diltiazem cream has been reported to improve procedural efficiency and patient outcomes.[23] Since the study mentioned here is of prospective design and the measurements were carried out objectively with ultrasonography, the findings may be speculated to be more reliable. However, the small sample size limits generalizability. Larger-scale trials are needed to confirm these benefits and explore potential broader applications, such as in emergency procedures or patients with significant comorbidities.

### Limitations

Participant allocation by odd/even numbering is not a valid method of randomization, lacks allocation concealment, and introduces substantial selection bias. No blinding was implemented at any level. Ultrasound operators or proceduralists were not blinded, increasing susceptibility to observer and performance bias.

## Conclusion

Topical diltiazem cream application may significantly improve radial artery cannulation success and reduce puncture time while decreasing complication rates in patients undergoing coronary angiography. This intervention may be a valuable adjunct in radial artery access preparation, especially for patients with smaller arteries or challenging anatomy. Further large-scale studies are recommended to confirm these findings.

### Disclosures

**Ethics Committee Approval:** The study was approved by the Private Edremit Korfez Hospital Ethics Committee (no: 3678777-12, date: 01/10/2023).

**Informed Consent:** Informed consent was obtained.

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