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Original Article

Effects of subcutaneously infiltrated nitroglycerin on diameter, palpability, ease-of-puncture and pre-cannulation spasm of radial artery during transradial coronary angiography



Babu Ezhumalai ^{a,*}, Santhosh Satheesh ^b, Balachander Jayaraman ^b

^a Department of Cardiology, Sri Venkateshwaraa Medical College Hospital and Research Centre, Puducherry, India

^b Department of Cardiology, Jawaharlal Institute of Postgraduate Medical Education and Research, Puducherry, India

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ABSTRACT

Background: The success of transradial catheterization depends on meticulous access of radial artery which in turn depends on palpating a good radial pulse.

Objectives: Our objectives were to analyze the effects of subcutaneously infiltrated nitroglycerin on diameter of radial artery, palpability of radial pulse, ease-of-puncture and pre-cannulation spasm of radial artery during transradial coronary angiography.

Methods: Patients undergoing transradial coronary angiography were randomized to Group NL or Group SL. In Group NL, 3 ml of solution containing nitroglycerin and lignocaine was infiltrated subcutaneously at the site intended for puncture of radial artery. Similarly, saline and lignocaine were infiltrated in Group SL. Diameter of radial artery was objectively assessed by ultrasonography. Measurements were performed at baseline and repeated at 1 min after injecting the solutions. The ease-of-puncture was evaluated by the number of punctures and the time needed for successful access of radial artery.

Results: Both groups had 100 patients each. Baseline diameter of radial artery was similar between two groups. The post-injection diameter of radial artery increased by 26.3% in Group NL and 11.4% in Group SL. Nitroglycerin significantly improved the palpability of radial pulse, reduced the number of punctures and shortened the time needed for successful access of radial artery. Pre-cannulation spasm of radial artery occurred in 1% of Group NL and 8% of Group SL.

Conclusions: Subcutaneously infiltrated nitroglycerin leads to significant vasodilation of radial artery. This avoids pre-cannulation spasm of radial artery, enhances palpability of the radial pulse and thus makes the puncture of radial artery easier.

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* Corresponding author. #5, Old Market Street, Mudaliarpet, Puducherry 605004, India. Tel.: +91 9443799346 (mobile).

E-mail address: drebabu@gmail.com (B. Ezhumalai).

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1. Introduction

Transradial approach of cardiac catheterization is considered more advantageous than transfemoral approach because it is more comfortable to the patient, associated with lesser incidence of access site complications, reduces the duration and cost of hospitalization.^{1–3}

Unlike transfemoral route, transradial approach for coronary angiography requires a longer learning curve.⁴ The success of transradial coronary angiography depends on obtaining a meticulous access of radial artery which in turn depends on palpating a good radial pulse. Although spasm of radial artery is usually encountered after cannulation and catheterization of radial artery,^{5,6} sometimes it may occur prior to cannulation due to multiple painful punctures.⁷ Radial pulse is usually lost with onset of this pre-cannulation spasm necessitating the switching over of approach to transfemoral route. The radial pulse may also become feeble after subcutaneous infiltration of local anesthesia and hence the puncture becomes difficult. This is an important reason for most operators hesitating to infiltrate the site of puncture with adequate local anesthesia, which is usually 2% lignocaine.

Previous studies proved that intravenous,^{8,9} topical,^{10,11} and intra-arterial^{12–14} routes of administration of nitroglycerin lead to vasodilation of radial artery. Very few studies had tested the effect of subcutaneous route of administration of nitrate/nitroglycerin on access of radial artery but they had shortcomings such as subjective endpoints, small sample size and lack of randomization.^{7,15,16} We decided to overcome all these shortcomings and hence we undertook our study.

2. Objectives

Our objectives were to analyze the effects of subcutaneously infiltrated nitroglycerin on diameter of radial artery, palpability of radial pulse, ease-of-puncture and pre-cannulation spasm of radial artery during transradial coronary angiography.

3. Materials and methods

This prospective, randomized, double blinded, placebo controlled study was carried out in a single center over a period of 6 months. Patients planned for transradial coronary angiography were included in this study. The exclusion criteria were hypotension (systolic blood pressure <100 mm Hg), prior cannulation of radial artery and abnormal Allen's test. Informed written consent was obtained from the participants and ethical committee approval was obtained from the institute for this study.

The procedure was carried out inside the cath lab just before starting transradial coronary angiography. Using block randomization, patients were allocated into either of the two groups namely (a) Group NL (nitroglycerin + lignocaine) and (b) Group SL (saline + lignocaine). Patients of Group NL received 3 ml of 'Solution A' containing 1 ml of nitroglycerin at a concentration of 500 mcg/ml and 2 ml of 2% lignocaine, while

those of Group SL received 3 ml of 'Solution B' containing 1 ml of normal saline and 2 ml of 2% lignocaine. Both these solutions were colorless, odorless and looked similar in appearance.

Baseline diameter of radial artery was assessed by experienced observer using 9 MHz vascular probe and echocardiographic machine. This observer was different from the operator performing the procedure of transradial coronary angiography. The distance between lumen–intima interfaces in the far wall and near wall of radial artery measured at peak of R wave of electrocardiogram (ECG) was taken as diameter of radial artery. Three successive measurements were performed and the mean was taken as the diameter of radial artery. Noninvasive blood pressure, ECG and pulse oximetry were continuously monitored during the procedure.

Transradial coronary angiography was performed by well experienced operator in this study. The operator assessed the baseline palpability of radial artery pulse and subcutaneously infiltrated 3 ml of local anesthetic solution at the site of maximal radial pulse just proximal to the wrist in the lateral aspect of the right forearm of patients using 26G hypodermic needle. One minute after the injection of local anesthetic solution, the diameter of radial artery was assessed again by the same observer. Then the operator reassessed the radial pulse and graded the change in palpability of radial pulse from 0 to 4 as follows:

- Grade 0: radial pulse not palpable after the injection
- Grade 1: radial pulse became feeble after the injection
- Grade 2: palpability of radial pulse remained the same after the injection
- Grade 3: radial pulse became better palpable after the injection
- Grade 4: radial pulse became bounding after the injection.

Radial artery was then punctured by the operator using 20G cannula. The ease-of-puncture was evaluated by (i) the number of punctures needed for successfully puncturing radial artery and (ii) the time needed for successful access of radial artery. The latter is defined as the period from the injection of local anesthetic solution to the successful insertion of sheath into radial artery. Pre-cannulation spasm was defined as spasm of radial artery occurring prior to insertion of sheath.

Statistical analyses were performed using SPSS software (SPSS Inc. Released 2007. SPSS for Windows, Version 16.0. Chicago: SPSS Inc). All statistical analyses were carried out for 5% level of significance and two-tailed *p* value < 0.05 was considered significant for all tests in this study.

4. Results

Out of 200 patients included in this study, 100 patients were randomly allocated to each of the two groups. The clinical profile of these patients is mentioned in Table 1. Patients included in the both the groups were age and sex matched. The risk factors for coronary artery disease such as obesity, diabetes mellitus, hypertension, smoking and dyslipidemia were also matched between the two groups. The assessment

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