

COMPARISON OF INTRAVENOUS VERSUS INTRA-ARTERIAL HEPARIN FOR THE PREVENTION OF RADIAL ARTERY OCCLUSION DURING TRANSRADIAL CORONARY ARTERY CATHETERIZATION

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ABSTRACT

Objective: To determine the relative efficacy of intravenous heparin as compared to intra-arterial heparin used during transradial coronary angiography for the prevention of radial artery occlusion.

Study Design: Comparative cross-sectional study.

Place and Duration of Study: Study was conducted at the Department of Cardiology, AFIC/NIHD Rawalpindi, Pakistan, from Jul 2019 to Dec 2019.

Methodology: A total number of 144 patients were considered for the study using the consecutive sampling technique who were undergoing diagnostic coronary angiography. Patients were divided into the intra-arterial group (n=72) who received 50 IU/kg of unfractionated heparin (maximal dose 5,000 U) intra-arterially, and an intravenous group (n=72) received the similar dose through intravenous route. All patients were administered 100 mcg of nitroglycerin to minimize radial artery spasm. Coronary Angiography was performed using a 6F introducer sheath and diagnostic catheters. Early radial artery occlusion (RAO) at 24 hours after the procedure was detected by performing the plethysmographic (reverse Barbeau's) and doppler USG evaluation. Chronic RAO was assessed 30 days after the procedure by performing the same tests. Data was collected through a pre-designed proforma and analyzed using SPSS 23. A *p*-value of less than 0.05 was considered as significant.

Results: Early RAO was found in 4 (5.6%) of the patients from the intra-arterial group and 5 (6.9%) of the intravenous group. The difference was found to be statistically insignificant (*p*-value 0.731). Chronic RAO was observed in 3 (4.4%) of the intra-arterial group as compared to 4 (6%) of the intravenous group. This difference was also statistically insignificant (*p*-value 0.683) for chronic RAO.

Conclusion: Intra-arterial and intravenous heparin administration provided similar efficacy to prevent RAO.

Keywords: Angiography, Heparin, Intra-arterial, Intravenous, Radial.

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INTRODUCTION

Trans radial access (TRA) has evolved to become the main access site around the world. It has proved to decrease the mortality and adverse cardiac events especially in high-risk patient groups as compared to trans femoral access. It is due to decreased major bleeding and access site-related vascular problems through transradial route. It also causes less patient discomfort. Moreover, TRA provides the advantage of early mobilization of patients and also minimize costs related to the procedure^{1,2}. Therefore, TRA has been recommended as a Class IA indication by the Euro-

pean Society of Cardiology for the patients of acute coronary syndromes undergoing invasive coronary catheterization³. However, TRA can be challenging and can have complications. TRA is technically more demanding and has a longer learning curve. Radial artery occlusion (RAO) is usually an asymptomatic complication of transradial procedures⁴ and is very well tolerated due to the dual blood supply of palmar arch. However, it prohibits the use of same radial artery for future procedures. RAO also disallows the benefits of radial access in high bleeding risk patients and radial artery cannot be utilized as a graft for the coronary artery bypass grafting (CABG). Incidence of RAO is variable and extends from 1% to 9%. RAO is caused by a thrombotic process

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initiated from the termination of flow due to introduction of catheter in the radial artery lumen and it is intensified by additional spread of the process owing to the occlusive hold⁵. Incidence of RAO can be reduced by the use of heparin⁶ which is administered through intravenous route by some operators while others prefer the intra-arterial route for heparin administration. Although the protective effect of heparin on RAO was established initially through intravenous route administration, heparin is mostly given through an intra-arterial route as a part of the "radial cocktail" by most operators these days. It is sometimes hypothesized that intra-arterial heparin can be more advantageous owing to the local effect. This study was designed to compare the efficacy of heparin in the prevention of RAO through intra-arterial versus intravenous route of administration.

METHODOLOGY

This comparative cross-sectional study was conducted at the Department of Cardiology, AFIC/NIHD Rawalpindi, Pakistan from July 2019 to December 2019. A total of 144 patients, aged 18 years or older, undergoing elective diagnostic coronary angiography, were considered for the study using the consecutive sampling technique. Patients were randomized into two equal groups. Intra-arterial group (n=72) received 50 IU/kg of unfractionated heparin (maximal dose 5,000 U) intra-arterially, whereas, the intravenous group (n=72) received the equivalent dose intravenously. The operator had no information about the route of administration. All patients received 100 mcg of nitroglycerin to minimize radial artery spasm. The modified Allen's test was performed prior to radial access. It was done by requesting patients to clench and hold their fist while radial and ulnar arteries were compressed simultaneously by the examiner. Blood flow to the hand was temporarily restricted by this maneuver which was evidenced by pale blanching of the skin. While the examiner released compression of the ulnar artery, the patient was then told to open their fist. The return of palmar colour to normal within 7 seconds was considered as normal mo-

dified Allen's test indicating adequate collateral circulation. Patients with abnormal modified Allen's test, the prior history of coronary artery bypass graft surgery and prior radial artery cannulation were excluded from the study. Angiography was performed using 6 French diagnostic catheters. Early RAO at 24 hours and chronic RAO at 30 days after the procedure was detected by plethysmographic evaluation using reverse Barbeau's test. This test involved placing a pulse oximeter sensor over the index finger. Examiner compressed both the radial and ulnar arteries to observe a loss of the plethysmographic signal. Next, the return of the plethysmographic signal was observed while the radial artery pressure was released which confirmed radial artery flow and patency. RAO was interpreted by the absence of the return of the plethysmographic signal. The pressure on the ulnar artery was then released to observe the return of the signal as a confirmation of appropriate functioning of the equipment. Doppler ultrasound evaluation was done to confirm all the cases of RAO and person doing the ultrasound assessment had no information about the route of heparin administration.

Data was entered and analyzed by IBM SPSS 23 after obtaining informed written consent for individual data and approval of Hospitals Scientific and Ethics Committee. Mean and standard deviation was calculated for quantitative variables like age and qualitative data were analyzed using the chi-square test and a *p*-value of less than 0.05 was considered significant.

RESULTS

The demographic variables are compared between the two groups in table-I. Intra-arterial group had early RAO (found at 24 hours of follow-up) in 4 (5.6%) of the patients and intravenous group had early RAO in 5 (6.9%) of patients. The difference was found to be statistically insignificant (*p*-value 0.731). Chronic RAO (found at 30 days of follow-up) was found in 3 (4.4%) of the intra-arterial group and in intravenous group, 4 (6%) of patients had chronic RAO. This difference was also not statistically significant (*p*-value

0.683) (figure). Radial artery spasm was noticed in 5.6% of the intra-arterial group and 4.2% of the intravenous group. The difference was statistically insignificant (*p*-value 0.698) (table-II).

Table-I: Clinical characteristics of patients (n=144).

Parameters	Mean ± SD / n (%)
Age	57.82 ± 9.309 years
Gender	
Male	88 (61.1)
Female	56 (38.9)
Smoking	25 (17.4)
Diabetes Mellitus	52 (36.1)
Hypertension	108 (75.0)
Dyslipidemia	27 (18.8)
Family history	20 (13.9)

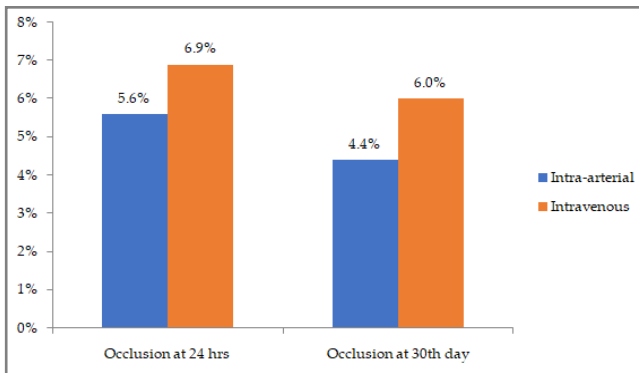


Figure: Incidence of the radial artery occlusion in intravenous and intra-arterial groups at 24 hours (*p*=0.731) and 30 days (*p*=0.683) after the procedure.

Table-II: Comparison of procedural factors between intra-arterial and intravenous groups.

Variables	Intra-arterial	Intravenous	<i>p</i> -value
Procedure success	71 (98.6%)	72 (100.0%)	0.316
Radial artery spasm	4 (5.6%)	3 (4.2%)	0.698

DISCUSSION

Radial artery occlusion is the most frequent post-procedural complication of radial access which restricts the future use of the radial artery for invasive procedures and as a conduit in CABG. Hence, avoidance of RAO is of paramount clinical importance and should be of prime concern⁷. Acute arterial thrombosis which results from the collective effect of catheter-related endothelial and vessel injury, local hypercoagulable state, and decreased blood flow from compres-

sive hemostasis act as the central process in early RAO after TRA. A considerable fraction of these patients will develop chronic RAO. The pathogenesis of chronic RAO involves progressive intimal-medial thickening due to vascular smooth muscle proliferation and hyperplasia as a response to injury during TRA^{8,9}. Therefore, careful precautionary measures are required in relation to various procedural and post-procedural factors involved in RAO. Procedure related parameters include recurring failed attempts of radial punctures, lack of aspirin pre-treatment, increased sheath-to-artery ratio and lack of periprocedural intravascular anticoagulation^{10,11-13}. Post-procedural risk factors specifically include non patent-hemostasis^{5,14,15} and prolonged time for hemostasis¹⁶⁻¹⁹. Anticoagulation during procedure is crucial to prevent RAO because thrombus formation is central factor leading to occlusion of radial artery. It is also apparent from the published literature that a major fraction of acutely occluded radial artery is found to be recanalized during the follow-up evaluation at one month after procedure⁴. This is most likely due to recanalization of the occlusive thrombus due to spontaneous fibrinolysis. The comparative dominance between fibrinolytic and thrombus organizational factors dictates whether the chronic occlusion of radial artery develops or there is spontaneous recanalization. The possibility of recanalization is aug-

mented by creating a systemically anticoagulated state through the maintenance of heparinized condition which inhibits prothrombotic processes and shifts the balance towards spontaneous fibrinolysis. A latest international survey has revealed that the most operators (92.5%) administer unfractionated heparin (UFH) with considerable variation in dosage and administration route during diagnostic transradial coronary angiography²⁰. The initial reports have also suggested that the efficacy of heparin in preventing RAO appears

to be dose-dependent as increasing the dose from 2,000 U to 5,000 U causes a significant additional decline in the incidence of RAO,²¹. Our results have revealed that intravenous heparin is equally effective to intra-arterial heparin in preventing RAO. Although heparin is administered directly into the instrumented radial artery, the intra-arterial route does not provide any added advantage in preventing RAO. This has further validated the major role played by the systemically anticoagulated state in preventing RAO, rather than the local effect by intra-arterial administration. Intravenous heparin administration might provide a minor advantage over intra-arterial administration due to the decreased burning sensation in the forearm as compared to the intra-arterial route. Data from research has also testified the additional efficacy of "patent hemostasis" in minimizing the incidence of RAO¹⁴. The efficacy of patent hemostasis has further signified the importance of maintaining blood flow in decreasing chronic occlusion by reducing the probability of occlusive thrombus formation at the access site.

CONCLUSION

Heparin plays an important role in preventing RAO after trans-radial access and can be administered by intravenous or intra-arterial route with equal efficacy. It is thus evident that maintenance of systemically anticoagulated is crucial in preventing RAO rather than local effect of intra-arterial administration.

CONFLICT OF INTEREST

This study has no conflict of interest to be declared by any author.

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