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Incidence of Radial Artery Occlusion After One Year in Patients Underwent Radial Interventions with Preprocedural Patent Radial Artery by Barbeau Test and Its Comparison with the Doppler Examination

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ABSTRACT

Aim of the study: To find the incidence of radial artery occlusion (RAO) at one year in patients who have radial interventions by using the Barbeau test. Materials and methods: Totally 105 patients are selected. Prior to the radial procedure oximetric Barbeau test was done in the patient's right index finger to see the type of response. Using oximetric probe the pulse waveform is displayed with both arteries open. The radial artery is compressed and the pulse wave of the ulnar flow is observed, similarly reverse Barbeau test is performed by occluding the ulnar artery and the radial artery waveform is observed. Oximetric Barbeau test is of four grades: Type A response is no damping of pulse waveform after 2 min of artery compression with positive oximetry, type B is damping of pulse waveform with positive oximetry, followed by complete recovery within two minutes, type C response is loss of pulse waveform and negative oximetry with partial recovery of pulse waveform and oximetry within two minutes, type D response is loss of pulse waveform and negative oximetry without recovery of either pulse waveform or oximetry after two minutes of compression. Radial artery cannulation is done in type A, B and C response and not recommended in type D. Oximetric Barbeau and reverse Barbeau test was performed on the next day, on the day of discharge and every 3 months for about one year. The Barbeau test assesses the radial artery, ulnar and deep palmer arch flow patency. Other parameters affecting the radial artery patency like the number of punctures involved in radial artery cannulation, hematoma after sheath removal, size of sheath used for radial artery cannulation and the fluoro time of the procedure also had been assessed. Results: Out of 105 patients, 50 patients had type B response,14 patients had type A response, 10 patients had type C response and 31 patients developed type D (29%) response in the reverse Barbeau test. Patients who had type D response were subjected for Doppler vascular probe examination to see the patency of right radial artery, in that 19 patients (18%) had occlusion, 7 had diminished flow and another 5 had normal triphasic flow. Conclusion: The incidence of radial artery occlusion after the radial procedures in our study showed 18%, which is similar to the previous study data of 5% to 30%. Radial artery occlusion is common in patients who had hematoma, increased fluoro time and use of increased sheath size. Barbeau test alone overestimates the radial artery occlusion (RAO). So, Doppler examination is necessary and confirmatory for assessing radial artery patency.

Keywords: Radial artery occlusion, Barbeau test

INTRODUCTION

Transradial access for diagnostic and interventional procedures is gaining more popularity supporting its superior safety from a standpoint of access site complications. This procedure is also readily accepted by patients because of increased comfort by eliminating the need for bed rest. Radial artery occlusion is one of the few postprocedural complications of TRA. It is clinically quiescent in properly selected cases and rarely results in ischemia. It limits future TRA. It also decreases patient confidence in the safety of the procedure despite its clinical quiescence [1]. It is probably related to the size of the introducer sheath and more likely related to the ratio of the arterial diameter to the sheath [2]. One of the methods used to diagnose radial artery occlusion involves performance of an inverse modified Allen test with pulse plethysmography which is graded as Barbeau A through D according to increasing severity of occlusion with grade D signifying more severe occlusion. To our knowledge, there has been no definite imaging studies confirming the accuracy of the inverse modified Allen's test with plethysmography in the diagnosis of RAO in

patients following transradial catheterization. However, we observed cases where patients demonstrating a Barbeau grade of D after diagnostic and interventional procedures whom we used inverse modified Allen's test with pulse plethysmography in comparison to Doppler ultrasound to diagnose RAO [3].

METHODS

This is a prospective non-randomized study of the 105 patients who underwent elective coronary angiography or PCI by radial route from May 2015-December 2016. This study was done in Madras Medical College hospital after getting consent from the patients and we also had Ethical committee approval for doing this study. Patients with prior radial intervention, pathological Allen tests, cardiogenic shock, decompensated heart failure, severe valvular disease, and chronic renal failure were not included in the study. All patients had a good pulsating right radial artery and a normal Barbeau test. Using oximetric probe the pulse waveform is displayed with both arteries open. The radial artery is compressed and the pulse wave of the ulnar flow is observed, similarly reverse Barbeau test is performed by occluding the ulnar artery and the radial artery waveform is observed. Oximetric Barbeau test is of four grades. Type A response is no damping of pulse waveform after two minutes of artery compression with positive oximetry, type B is damping of pulse waveform with positive oximetry, followed by complete recovery within two minutes, type C response is loss of pulse waveform and negative oximetry with partial recovery of pulse waveform and oximetry within two minutes, type D response is loss of pulse waveform and negative oximetry without recovery of either pulse waveform or oximetry after two minutes of compression. Radial artery cannulation is done in type A, B and C response and not recommended in type D. Oximetric Barbeau and reverse Barbeau test was performed on the next day, on the day of discharge and every 3 months for about one year. The Barbeau test assesses the radial artery, ulnar and deep palmer arch flow patency. Prior to discharge and every three month follow-up, all patients were examined. Pulsation of the radial artery was examined by palpation at and near the original entry site, as well as by repetition of the Barbeau and reversed Barbeau tests. A two-dimensional and Doppler ultrasound study of the puncture site was performed in most patients as well as in every patient presenting clinical evidence of radial artery occlusion. Radial artery occlusion was defined as the absence of palpable radial pulsations, confirmed by: a negative reversed Barbeau test, and/or the absence of a Doppler flow signal at or distal to the original entry site. Spontaneous recanalization was defined as the recurrence of palpable radial pulsations, confirmed by a positive reversed Barbeau test, and/or return of a normal Doppler flow signal.

Baseline patient parameters

Patients selected for the study mainly includes acute coronary syndrome in the form of either anterior wall myocardial infarction, inferior wall myocardial infarction, effort angina Class-II and TMT positive patients. Most of the risk factors like diabetes, hypertension, smoking, alcoholic and dyslipidaemia were found in the patients.

RESULTS

The clinical features of the study population are shown in Table 1.

Table 1 Clinical features of the study population

Demographic features	No-105
Age	58 ± 10 years
Male	87
Female	18
AWMI	75
IWMI	23
Unstable angina	5
HOCM	2
Diabetes	86
Hypertension	75
Hypothyroidism	7

Smoker	56
Alcoholic	35
Dyslipidaemia	32
Haematoma	39

The mean age of all patients was 56.3 year, with 75% being male. Out of 105 patients, 31 patients (29%) had clinical evidence of radial artery occlusion at discharge. Persistent occlusion was found in 19 patients (18%). The characteristics of patients with radial artery occlusion are shown in Table 2. We did not find any evidence of radial artery occlusion occurring after hospital discharge. All patients with evidence of artery occlusion at 1 month follow-up already had clinical evidence of occlusion at discharge. None of the patients with radial artery occlusion were treated with prolonged heparinization or coumadines. None of the patients with temporary or persistent radial occlusion had clinical sequelae such as claudication or necrosis of the hand. Out of 105 patients, 50 patients had type B response,14 patients had type A response, 10 patients had type C response and 31 patients developed type D (29%) response in the reverse Barbeau's test at the end of one year (Figure 1). Among the 105 patients those who had Type-D response (31 patients) with evidence of RAO clinically were subjected for Doppler probe vascular examination for assessing the triphasic radial artery flow pattern. To our surprise in that Doppler examination out of 31 patients, 19 patients (18%) had occlusion as there is no flow found in the Doppler probe, 7 had diminished flow and another 5 had normal triphasic flow (Figure 2). Hence, radial artery occlusion assessed by Barbeau test alone over estimates. So, Doppler examination is essential and necessary in diagnosing the RAO exactly. Figure 3 shows comparison of reverse Barbeau test with Doppler examination.

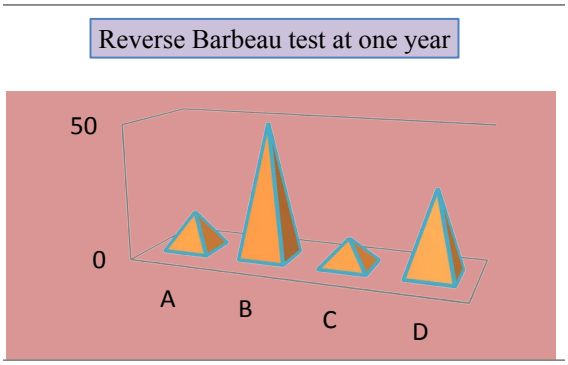

Figure 1 Percentage of Response in Barbeau test

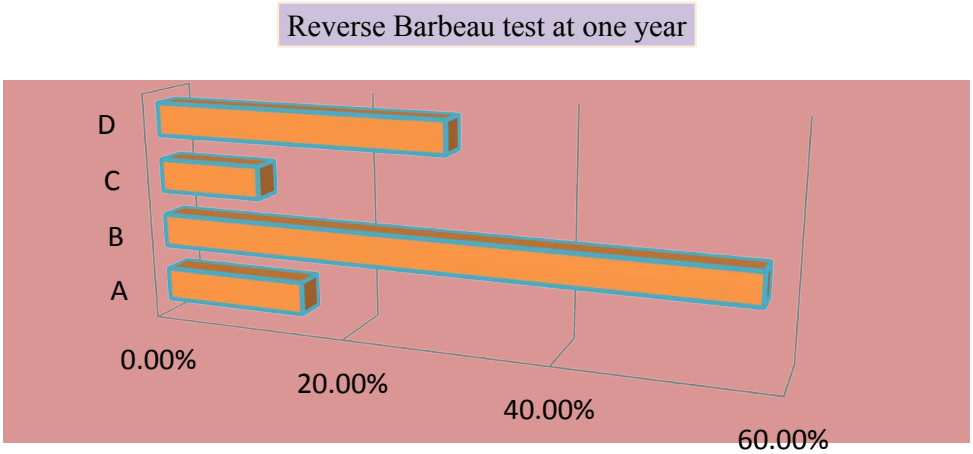

Figure 2 Comparison of RAO between the Reverse Barbeau test with Doppler examination

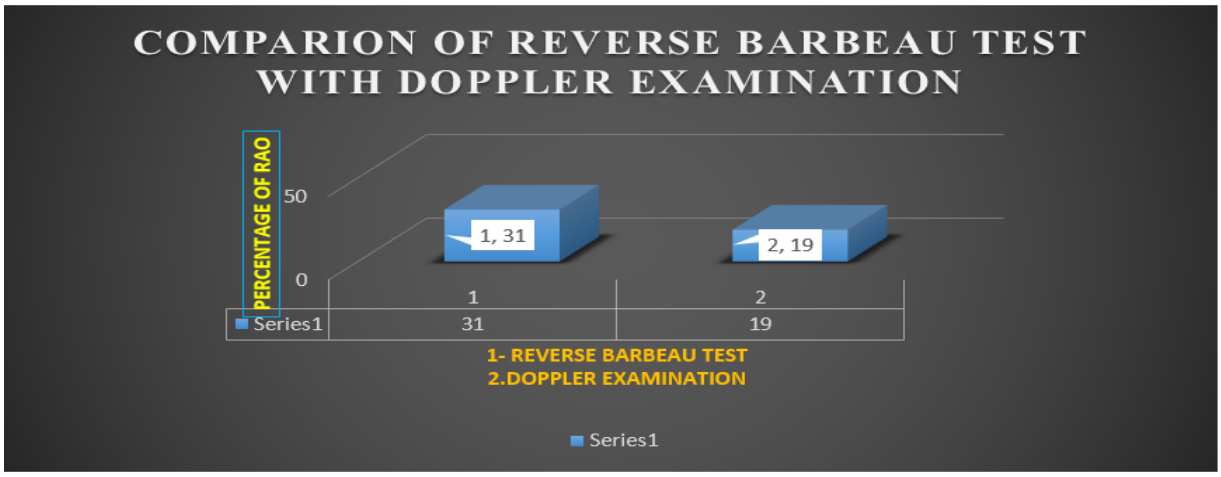

Figure 3 Comparison of reverse Barbeau test with Doppler examination

DISCUSSION

Access-site complications after interventional cardiovascular procedures remain a serious problem in modern cardiology. Miniaturization of interventional equipment has created the possibility of performing these procedures through smaller arteries such as the radial artery because of the anatomy of the radial artery, bleeding complications are easily managed. Thrombotic or traumatic occlusion of the vessel should in theory not endanger the viability of the hand if a double blood supply through the ulnar arch is present [4]. Our study was performed with 6F introducer sheaths (outer diameter 7F), and with 6F guiding catheters in patients planned for radial angioplasty and 5F in coronary angiogram. In comparison with the literature, we found a very low incidence of radial artery occlusion. A key factor in the prevention of occlusion might be the short duration of cannulation. Bedford and Wollman found a 25% incidence of radial occlusion after a relatively short duration of cannulation (<20 h), as opposed to a 50% occurrence of radial occlusion in cannulations lasting >24 h [5].

Another important factor in the prevention of occlusion might be the immediate post-procedural sheath removal, while patients were still under heparinization, followed by post-procedural treatment with aspirin and clopidogrel. Lefevre et al. found a significant reduction of radial occlusion after administering 5000 IU of heparin during the procedure, in comparison with 1000 IU doses previously administered. We also found a trend toward a lower incidence of radial artery occlusion after more aggressive anticoagulation [6].

Table 2 Collective data of patients with Type D response in the reverse Barbeau test

S.No.	Risk Factors	Ejection Fraction	Number of Punctures	Sheath size	Fluoro time	Haematoma	Diagnosis
1	DM SHT	45%	1	5F	4.0 Min	+	ACS
2	S, A, DLP	50%	1	5F	2.0 Min	-	ACS
3	DM, SHT	60%	1	5F	3.4 Min	+	ACS
4	DM	44%	1	5F	5.2 Min	+	ACS
5	DM, SHT	39%	2	6F	8.5+21.7	+	ACS
6	DM, SHT	53%	1	6F	4.3+14.9	+	ACS
7	DM, SHT	47%	1	5F	4.9 Min	+	ACS
8	S, A, DLP	55%	1	5F	11.2 Min	+	ACS
9	A	48%	1	6F	55.1 Min	+	ACS
10	DM, SHT	60%	1	5F	9.3 Min	+	ACS
11	SHT, SA, DLP	60%	1	5F	8.6 Min	+	ACS
12	DM, SHT	43%	1	5F	3.6 Min	-	ACS

13	DM, HYP, A	50%	1	6F	4.8+26.4	-	ACS
14	SHT	50%	1	6F	12.3 Min	-	ACS
15	DM	40%	3	6F	2.1 Min	-	ACS
16	-	40%	7	6F	43.8 Min	-	ACS
17	DM, SHT	55%	1	6F	5.7 Min	+	ACS
18	-	50%	1	6F	9.2 Min	+	ACS
19	DM, SHT	40%	1	6F	3.5 Min	+	ACS
20	-	23%	1	6F	3.1 Min	+	ACS
21	DM, SHT	30%	1	6F	15 Min	+	ACS
22	DM, SHT, A, S, DLP	60%	2	6F	4.7 Min	+	ACS
23	DM	65%	1	6F	9.4 Min	+	EA
24	DM, SHT	40%	1	6F	7.0 Min	+	ACS
25	-	50%	1	6F	4.2 Min	+	ACS
26	SA, DLP	65%	3	6F	14.6 Min	+	EA
27	-	63%	2	6F	17 Min	+	EA
28	DM, SHT	50%	1	6F	18.6 Min	+	ACS
29	-	65%	3	5F	7.7 Min	+	ACS
30	DM	65%	1	5F	3.4 Min	+	ACS/UA
31	DM, SHT	50%	2	5F	9.9 Min	+	ACS

S-Smoker, A-Alcoholic, DLP-Dyslipidaemia, HYP-Hypothyroidism, SHT-Systemic Hypertension, DM-Diabetes mellitus, ACS-acute coronary syndrome,

On analysing the data of patients with type-D response with the reverse Barbeau test (Table 2), most of the patients were diabetic, patients who had haematoma after the procedure are very much prone to get radial artery occlusion. Regarding the fluoro time, patients who had more than 3 minute fluoro time are more prone to get radial artery occlusion. Number of punctures needed for radial artery cannulation has no significant correlation with the occlusion rates of radial artery. Radial artery sheath size also had influence in RAO, by using 6F sheath the occlusion rates are more (up to 30%) compared with 5F sheath size (5% to 10%). In our study, mostly we used 6F sheath hence we have RAO rate of 19%.

Radial artery occlusion assessed by Barbeau test alone overestimates. So, Doppler examination is essential and necessary in diagnosing the RAO exactly. Our study shows RAO of 29% with reverse Barbeau test which overestimates the occlusion rates. By Doppler examination the RAO turned out to be 19% which was showing the same in many previous study data.

CONCLUSION

The incidence of radial artery occlusion after the radial procedures in our study showed 18%, which is similar to the previous study data of 5% to 30%. Radial artery occlusion is common in patients who had hematoma, increased fluoro time and use of increased sheath size. Barbeau test alone overestimates the radial occlusion (RAO). So, Doppler examination is necessary and confirmatory for assessing radial artery patency.

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