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Radial and Ulnar Artery Size in Bangladeshi Population Coming for Cardiac Catheterization

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ABSTRACT

Background: Transradial approach has now become a preferred route for cardiac catheterization. However, smaller size of the artery, being liable to sustain injury during the procedure, this approach may even lead to permanent occlusion. This study is intended to measure the diameter of radial and ulnar artery and to identify the factors influencing the size of the arteries.

Methods: Using two dimensional ultrasound and Doppler examination, the inner diameter of right radial and ulnar arteries were measured in 373 consecutive patients with normal Allen test who underwent coronary angiogram (CAG) and/or percutaneous coronary intervention (PCI) through trans-radial approach in Ibrahim Cardiac Hospital and Research Institute (ICHRI), Dhaka from August 2013 to September 2014.

Results: The mean size of the radial and ulnar arteries were 2.2 ± 0.3 mm and 2.1 ± 0.3 mm respectively. There was no significant correlations of age with size of radial and ulnar artery ($r = 0.055$, $p = 0.290$ and $r = 0.010$, $p = 0.846$ respectively). However, sex was found to be associated with size of the arteries with male having greater size compared to their female counterparts (2.1±0.3 vs. 2.0±0.2 mm, $p = 0.001$ and 2.0 ± 0.3 vs. 1.9 ± 0.3 mm, $p = 0.006$ respectively). BMI was found to bear significant correlation with size of radial and ulnar artery ($r = 0.137$, $p = 0.008$ and $r = 0.121$, $p = 0.019$ respectively). Likewise, smokers and dyslipidaemics had bigger size of radial and ulnar arteries compared to their non-smoker and non-dyslipidemic counterparts ($p = 0.015$ & $p = 0.017$ respectively and $p < 0.001$ & $p = 0.011$ respectively). However, hypertension and diabetes did not influence the size of radial and ulnar arteries ($p = 0.559$ and $p = 0.916$; $p = 0.778$ and $p = 0.931$ respectively).

Conclusion: Diameter of radial and ulnar arteries of Bangladeshi population is a bit smaller but does not vary much with other population around the world. Male, smoker, obese and dyslipidaemic persons generally have bigger size of the radial and ulnar arteries, while age, hypertension and diabetes do not bear any relationship with size of the arteries.

Key words: Radial and ulnar artery diameter, trans-radial approach.

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INTRODUCTION

The trans-radial approach for cardiac catheterization is increasingly becoming popular globally over the trans-femoral approach. First trans-radial angiography was reported by Campeau et al. in 1989,[1] thereafter the first trans-radial coronary stenting was reported by Kiemeneij and Laarman in 1993.[2] A meta-analysis demonstrated that the trans-radial approach was associated with a shorter hospital stay, lower costs, and a lower rate of bleeding complications than the femoral approach.[3]

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Trans-radial approach also offers greater satisfaction for the patient as a result of increased comfort, mobility and convenience for conservative females. There is also added advantage for patients with back problems because there is no need for heavy pressure on the leg and prolonged immobility.[4] But there are some limitations, such are small diameter of the radial artery, incidence of spasm or existence of a complicated tortuous radial artery which may lead to failure of trans-radial approach or its complications[5] like artery perforation, aortic dissection or mediastinal bleeding.[6-8] Post-procedural permanent radial artery occlusions (RAO) although not frequent (1-10% in different reports),[9-14] small sized artery usually predisposes to develop RAO.

A previous study showed that with a smaller radial artery diameter, particularly if the arterial lumen-to-sheath diameter ratio is less than one, the risk for the development of RAO significantly increases.[15] So among the several factors the size of the artery is of utmost importance for judging the suitability of selecting trans-radial approach. The assessment of radial artery diameter before the procedure is beneficial for the interventional cardiologist. However, in case of negative reverse Barbeau test, smaller radial artery diameter or excessive tortuosity of the radial artery on Duplex study in pre procedural check up trans-radial approach may have to be abandoned, and trans-ulnar approach may be adopted as an alternative access site for percutaneous coronary procedures.

The latter can be readily performed with same efficacy and safety by operators familiar with the transradial approach.[16-18] There are many studies in different population[19-25] to see the size of radial artery with or without the size of ulnar artery. But there is no such study in our population. The aim of the present study is, therefore, to assess the inner diameter of radial and ulnar arteries in Bangladeshi population and also to identify the factors influencing the size of the arteries.

METHODS

Study patients

Between August 2013 to September 2014, a total of 373 consecutive patients with normal Allen Test who underwent coronary angiogram (CAG) and/or percutaneous coronary intervention (PCI) through trans-radial approach in Ibrahim Cardiac Hospital and Research Institute, Dhaka, Bangladesh were selected for this study. Having obtained approval by the Institutional Medical Ethics Committee, informed written consent was taken from the patients or their family members. Pre-existing risk factors for coronary artery disease and the factors which might influence the artery size like age, sex, height, weight, diabetes mellitus, hypertension, dyslipidemia and smoking/ tobacco consumption were recorded.

Measurement of radial and ulnar arteries

As majority of the procedure in this hospital are done through right radial approach the ultrasonic examination of the right radial and ulnar arteries were performed by an experienced cardiologist by a Vivid 7 pro GE echocardiography machine using 10 S linear transducer under supervision of a vascular surgeon on or a day before the procedure. Transducer was placed vertically to the arterial wall. Three parameters of internal diameter of right radial & ulnar arteries were measured within 5 cm of the styloid process of radius and ulna respectively. Then the average of the three measurements of each artery was used for analysis. Statistical analysis was done using SPSS (Statistical Package for Social Sciences), version 16.0. The test statistics used to analyse the data were Chi-square Test and Unpaired t-Test and the level of significance was at 0.05.

RESULTS

Demographic and clinical characteristics of the subjects

The mean age of the patients was 53.6 years (range: 27-80 years). Over two-thirds (67.9%) of the patients were ≥50 years and 20.9% 40-50 years old. Nearly three-quarters (73.7%) were

male. Approximately 43% of the patients were overweight and 10.7% obese (Table I). Two-thirds (66.5%) of the patients were hypertensive, 58.4% diabetic, 32.7% dyslipidaemic and 26.5% smoker and a few (1.1%) had peripheral vascular disease (Fig. 1). The mean size of the radial and ulnar arteries were 2.2 ± 0.3 mm (range: 1.6 - 3.0 mm) and 2.1 ± 0.3 mm (range: 1.3 - 3.0 mm) respectively (Table II).

TABLE I. Distribution of respondents by their baseline characteristics (n=373)

Baseline characteristics	Frequency	Percentage
Age (years)*		
<30	2	0.5
30 - 40	40	10.7
40 - 50	78	20.9
≥50	253	67.9
Sex		
Male	275	73.7
Female	98	26.3
BMI		
Under weight	6	1.6
Normal BMI	165	44.2
Over weight	158	42.4
Obese	40	10.7
Morbid obesity	4	1.1

***Mean age** = (53.6 ± 10.4) years; **range** = (27 - 80) years#

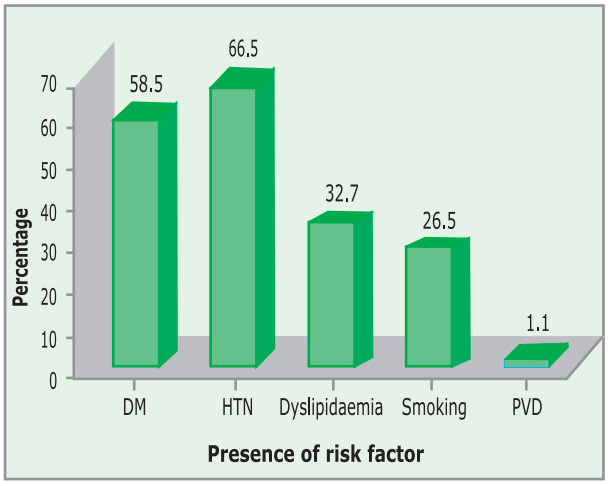

FIGURE 1: *Distribution of respondents by their risk factor (n=373)*

TABLE II. Distribution of respondents by their pre-procedural check-up (n=373)

Pre-procedural check-up (mm)	Mean ± SD	Range
Size of radial artery (mm)	2.2±0.3	1.6-3.0
Size of ulnar artery (mm)	2.1±0.3	1.3-3.0

Correlation between variables of interest:

There was no significant correlations of age with size of radial and ulnar artery (r = 0.055, p = 0.290 and r = 0.010 and p = 0.846 respectively). However, BMI was found to exhibit significant correlations with size of radial and ulnar artery (r = 0.137, p = 0.008 and r = 0.121, p =0.019 respectively) [Fig. 2a & b].

Association between risk factors and size of radial and ulnar artery:

Size of radial and ulnar arteries was significantly greater in male subjects compared to that in their female counterparts (2.1 ± 0.3 vs. 2.0 ± 0.2 mm, p = 0.001 and 2.0 ± 0.3 vs. 1.9 ± 0.3 mm, p = 0.006 respectively) [Table III]. Likewise, smokers and dyslipidaemics had bigger size of radial and ulnar arteries compared to their non-smoker and non-dyslipidemic counterparts (p = 0.015 & p = 0.017 respectively and p < 0.001 & p = 0.011 respectively) [Table IV & V]. However, hypertension and diabetes did not influence the size of radial and ulnar arteries (p = 0.559 and p = 0.916; p = 0.778 and p = 0.931 respectively) [Table VI & VII].

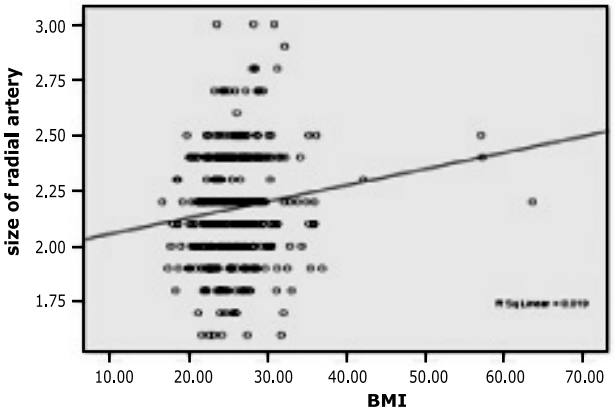

FIGURE 2a: *Correlation between BMI and size of radial artery*

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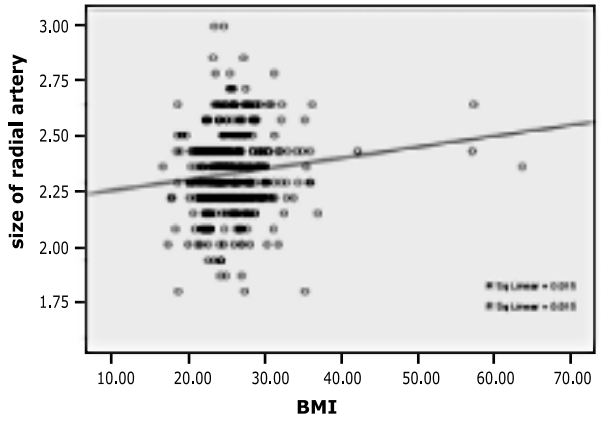

FIGURE 2b: Correlation between BMI and size of ulnar artery

TABLE III. Comparison of size of arteries between male and female

Artery#	Male (n=275)	Female (n=98)	p-value
Size of radial artery (mm)	2.1±0.3	2.0±0.2	0.001
Size of ulnar artery (mm)	2.0±0.3	1.9±0.3	0.006

#Data were analyzed using Unpaired t-Test and were presented as mean ± SD.

TABLE IV. Size of radial & ulnar arteries in smoker and nonsmoker

Artery#	Smoking habit		p-value
	Yes (n = 99)	No (n =274)	
Size of radial artery (mm)	2.2±0.3	2.1±0.2	0.015
Size of ulnar artery (mm)	2.1±0.3	2.0±0.3	0.017

#Data were analyzed using Unpaired t-Test and were presented as mean ±SD.

TABLE V. Size of radial & ulnar arteries in dyslipidaemic and non-dyslipidemic

Artery#	Dyslipidaemia		p-value
	Yes (n=122)	No (n=251)	
Size of radial artery (mm)	2.2±0.3	2.1±0.2	<0.001
Size of ulnar artery (mm)	2.1±0.3	2.0±0.3	0.011

#Data were analyzed using Unpaired t-Test and were presented as mean ± SD.

TABLE VI. Size of radial & ulnar arteries between hypertensive and normotensive.

Artery#	HTN		p-value
	Yes (n = 248)	No (n = 125)	
Size of radial artery (mm)	2.2 ± 0.3	2.2 ± 0.3	0.559
Size of ulnar artery (mm)	2.1 ± 0.3	2.1 ± 0.3	0.916

#Data were analyzed using Unpaired t-Test and were presented as mean ± SD.

TABLE VII. Size of radial & ulnar arteries between diabetic and nondiabetic

Artery#	DM		p-value
	Present (n=218)	Absent (n=155)	
Size of radial artery (mm)	2.2 ± 0.2	2.2 ± 0.3	0.778
Size of ulnar artery (mm)	2.1 ± 0.3	2.1 ± 0.3	0.931

#Data were analyzed using Unpaired t-Test and were presented as mean ± SD.

DISCUSSION

The diameter of the radial artery is very important for successful transradial coronary angiogram or PCI. Preprocedural measurement of the artery diameter will help cardiologists to select suitable case thereby avoiding injury to the radial artery and also to avoid postprocedural RAO. In our study the mean sizes of right radial artery (RRA) and right ulnar artery (RUA) were 2.2 ± 0.3 mm (range 1.6-3.0 mm) and 2.1 ± 0.3 mm (range 1.3-3.0) respectively. Several studies conducted abroad reported almost similar findings. Loh and associates[19] in a population of multiracial society of Singapore, found mean RRA diameter of 2.45 ± 0.54 mm whereas Yan et al[20] found mean RRA diameter of 2.38 ± 0.56 mm and mean RUA diameter of 2.35 ± 0.49 mm in Chinese population. Ashraf et al[21] in a study in Pakistan demonstrated mean diameter of RRA and RUL to be 2.3 ± 0.4 mm and 2.4 ± 0.4 mm respectively. In a recent study in a local population of Texas by Velasco et al,[22] the mean diameter of RRA was found to be 2.22 ± 0.35 mm. In our neighboring country India, the mean diameter of RRA and RUA was reported to be 2.35 ± 0.49 mm and 2.26 ± 0.44 mm respectively.[23] However, in another study on a

ethnic group in southern Chinese population, the mean diameter of RRA and RUA were found larger (3.04 ± 0.43 and 3.03 ± 0.38 mm).[24] In our study the size of RRA is larger than RUA which correlates with Loh et al[19] who found radial artery size to be significantly larger than the ulnar artery ($p < 0.0001$) where as it contrast with Ashraf et al[21] who found ulnar artery diameter to be larger than the radial artery diameter in Pakistani population.

As factors suspected to be associated with size of arteries were analysed, males, smokers, obese and dyslipidaemic persons exhibited bigger size of the radial and ulnar arteries, while age, hypertension and diabetic do not bear any relationship with size of the arteries. In a similar study Velasco et al[22] did not find any correlation with size of radial and ulnar arteries with age[22] but Loh et al[19] found age to affect the size of radial artery negatively. In terms of gender, majority of the above mentioned studies[19-23] found size of the radial and ulnar arteries to be significantly larger in males which correlate well with the present study. But Okere et al[25] in their study in USA did not find sex and BMI to be associated with size of the vessels. Loh et al[19] found dyslipidemic persons having larger size of arteries and diabetics having narrower arteries and smokers having no effect on size of artery. Pal and colleagues[23] found no effect of smoking or dyslipidaemia on size of artery. In contrast, Ashraf et al[21] found diabetes to affect positively. However, like Pal et al[23] and Yan et al[20] we failed to find any association of hypertension with size of radial and ulnar arteries but Loh et al[19] found considerably greater size of radial and ulnar arteries in hypertensive patients. The findings of the present study as compared and contrasted with other similar studies revealed that size of the radial and ulnar arteries does not vary widely except in certain ethnic population, but the factors affecting the size of the arteries vary greatly in population to population. Finally, we would like to mention that the present study was conducted on a small sample size and, as such, caution is advised to generalize the findings to reference population.

CONCLUSION

From our study we found that the diameter of radial and ulnar arteries of Bangladeshi population is a bit smaller but does not vary much with other population around the world. Males, smokers, obese and dyslipidaemic persons generally have bigger size of the radial and ulnar arteries, while age, hypertension and diabetes do not bear relationship with size of the arteries.

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