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Comparison of Fluoroscopy Time during Right Trans-Radial Coronary Angiography between Amplatz 2 and Judkins Catheters in Patients with Pseudo Lusoria

Mostafa Ahmadi [1], Laya Valaei [2]*, Yalda Ravanshad [3]

1. **MD. Cardiologist, Assistant professor, Cardiovascular Research Center, Department of Cardiology, Qaem Hospital, Mashhad University of Medical Sciences, Mashhad.**
2. **MD. Resident of Cardiology, Cardiovascular Research Centre, Student Research Committee, School of Medicine, Imam Reza Hospital, Mashhad University of Medical Sciences, Mashhad, Iran.**
3. **MD. Department of Community Medicine, Mashhad Branch, Islamic Azad University, Mashhad, Iran.**

***Corresponding author address: Department of cardiology, Ghaem Hospital, Mashhad, Iran.**
Email: lvalaei@yahoo.com. Tel: 05138012739. Fax: 05138409612.

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Abstract

Background: Acquired tortuosity of the right subclavian artery may influence the outcome of right trans-radial coronary angiography using conventional catheters. There is not enough evidence available for choosing the best angiographic catheter for patients with some unique tortuosity or angling of subclavian artery. The aim of this study was to compare the procedure duration of coronary angiography using Amplatz left 2 (AML2) catheter with left judkins catheters in patients with "pseudo lusoria".

Methods: This clinical trial was conducted in Qaem Hospital, Mashhad, Iran during 2017-2018. All patients undergoing coronary angiography were screened and 47 patients with a vascular anomaly called as "pseudo lusaria" were identified. The "pseudo lusoria"was define as "pseudo lusoria"which is defined as a short angle between brachiocephalic artery and subclavian artery during angiography. Patients with "pseudo lusoria"were randomly divided in two equal groups; AML2 and Left Judkins. A checklist including demographic and clinical data was filled for all patients and the duration of fluoroscopy from extraction of 0.0035 wire till engagement of coronary ostium was recorded.

Results A total of 47 patients (25, 53.2% male and 22, 46.8% female) were diagnosed with "pseudo lusoria". There was no significant difference in demographic characteristics, echo cardiograph and electro cardiograph of patients between groups. The use of AML2 catheter was associated with increased potential to perform the procedure in a shorter time shorter than 120 seconds compared to left Judkins (P<0.001).

Conclusions The use of AML2 catheter might be beneficial in right trans-radial coronary angiography in "pseudo lusoria"cases. Decrease in fluoroscopy time and as a result, decrease of radiation exposure for both clinician and patient. Also, decrease in manipulation of large vessels and as a result, decrease in vascular complications during and after procedure

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Keywords: Subclavian Artery; Trans-radial coronary angiography; Aortic Anomaly

Introduction

Cardiovascular disease (CVD) is a major cause of global morbidity and mortality in the 21st century (1, 2). Coronary artery disease (CAD) is a common disease and accounts for 51% of the CVDs (3, 4). Coronary angiography is the most important and definite method for diagnosis of CVD and is being used increasingly worldwide (5). Only in the United States, 2 million coronary angiographies are performed annually for both diagnostic and treatment purposes (3, 4). Similar to other medical procedures, coronary angiography is also associated with side effects including myocardial infarction, cerebrovascular accidents and arrhythmias as well as vascular complications, hypersensitivity to angiography dye and even death (3). Bleeding, hematoma and ecchymosis due to vascular trauma are among the most common complications of coronary artery catheterization (6). Angiography is performed using two main approaches including the radial and femoral approach (7, 8). Arteries with abnormal shape and fortuities are big challenges for those who prefer to use trans-radial approaches. When approaching the subclavian artery, anatomic abnormalities as well as tortuosity and stiffness are 2 big concern during angiography (9).

Arteria lusoria is one of these anatomic variation in subclavian artery. This abnormality is a rare finding involving the right subclavian artery and is mostly seen in patients with progressive uncontrolled hypertension or severe aortic lesions. The contraction and dilation of aorta results in alteration of the anatomical location of aorta especially between the beginning of aortic arch and brachiocephalic artery (9-12). As same as Arteria losaria, in some patients with same risk factors such as hypertension, we have faced same complication with passing the wire through the ascending aorta. The tortuosity and angling between the subclavian and brachiocephalic trunk makes it hard to pass the wire easily and make the angiography with common catheters more complicated. We have named this condition as “pseudo losaria” as it’s similar with arteria losaria in management during angiography. Usually, there is a need for a more flexible catheter to be able to pass throught the ascending aorta with deep breath. Also in such cases, there is a definite need for a more flexible catheter in coronary cannulation such as those with arteria losaria (13). Left and right Judkins catheters are the most commonly used catheters in coronary angiography while the Amplatz left (AML) and right catheters are the choice in case of anomalous vessels (14). The aim of this study was to assess the efficacy of AML catheter compared to other commonly used catheters for engaging left main artery in coronary angiography using right trans-radial approach in patients with specific subclavian artery tortuosity and angling which has been termed as “pseudo losaria” by our team.

Materials and methods

Study subjects

This clinical trial was performed on all patients who were candidate for angiography in the Qaem hospital, Mashhad, Iran (trial registration code: IRCT20180617040123N1). All of the patients were approached by the researchers and were informed about the study objective and procedure. Patients who were willing to participate in the study were included in the study after signing a written informed consent. The study duration was one year period starting from June 2017 to June 2018.

Sample size

Since no previous studies have been performed on “pseudo losaria”, this study was conducted on all patients that were identified with “pseudo losaria” in the duration of the study (47 patients).

ISSN: 0975-3583, 0976-2833 VOL13, ISSUE05, 2022

Study procedure

The study protocol was approved by the Mashhad University of Medical Sciences Ethical Committee. A questionnaire including demographic data and past medical history was filled for each patient prior to angiography. Suspicious patients for pseudo lusoria were identified based on the history of hypertension or aortic valvular disease prior to angiography. According to our team's previous experiences, some patients with an acute angle between subclavian artery and brachiocephalic trunk experience difficulties during angiography. Passing the wire to ascending aorta requires more maneuvers in these patients and has been usually left unsuccessful, even ending up in trans-femoral catheterization in our unit. The diagnosis of "pseudo losaria" was made during angiography by detecting a short angle between brachiocephalic artery and subclavian artery ($< 70^0$) as well as a $<90^0$ angle between brachiocephalic trunk and aorta (Figure 1). Suspicious subjects were randomly divided into two groups; Amplatz left 2 (AML2) and Left Judkins catheters. As the skill of the interventionist can affect the results of angiography, all the coronary angiographies were performed by single interventionist which was expert in using the mentioned catheters. Failure was defined as fluoroscopy time more than 120 seconds from extraction of 0.0035 wire till the engagement coronary ostium.

Statistical analysis

Data was analyzed using the statistical package for social sciences (SPSS) software version 22. (IBM Inc, Chicago, Il, USA) Continuous data were checked form normality using the Shapiro-Wilk test. Normally distributed variables were presented as mean and standard deviation (SD) while the non-normally distributed variables were presented as median and interquartile range (IQR). Categorical variables were presented as frequency and percentage. Comparison of continuous variables between groups was performed using independent t-test for normally distributed variables and Mann0Withney test for non-normally distributed variables. Comparison of the distribution pattern of categorical variables was performed using the chi-square or Fisher exact test based on the number of participants in each cell. The value of p smaller than 0.05 was considered statistically significant.

Results

A total of 47 patients (25, 53.2% male and 22, 46.8% female) participated in the study. The median and IQR of age were 51.00 and 21.00 years. The 2 type of catheter were AML2 (24 patients) and Judkins (23 patients). The ECG and echocardiographic findings of patients are presented in Table 3. There was no significant difference in term of ECG and echocardiographic findings between types of catheter ($p>0.05$ for both) (Table 3). The fluoroscopy time was significantly shorter in the AML2 group compared to Judkins ($p<0.001$). Among those patients in whom the fluoroscopy performed less than 120 seconds, the mean procedure time was significantly shorter in AML2 group compared to Judkins group ($P=0.001$). In unsuccessful procedures, trans-radial approach was changed to femoral approach or the catheter was changed to other universal catheters for radial approach. After the procedure, 2 patients reported diplopia which lasted for more than 24 hours and brain MRI revealed thromboembolism ($P=0.23$) (table 3). The symptoms gradually resolved after 24 hours in both patients.

Discussion

To the best of our knowledge, this study is the first clinical trial performed on patients with subclavian artery with specific arterial tortuosity and angle. Most of the available studies have evaluated subclavian artery anomalies which are mostly termed as aberrant subclavian artery and arteria losaria. Tortuosity and stiffness of subclavian artery has been considered as common factors which can complicate the trans-radial angiography (15). The findings of this study revealed that the prevalence of hypertension was

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78.7% among patients with "pseudo lusoria". This finding was in line with the findings of previous studies as chronic uncontrolled hypertension was previously shown to be associated with arteria lusoria (9-12, 16-18). Based on the findings of the current study, the prevalence of diabetes and hyper-lipidemia among patients with "pseudo lusoria" were 46.8% and 29.8% which was in congruent with the previously reported prevalence of these conditions among non-pseudo lusoria patients undergoing coronary angiography (19, 20). Although aortic valvular disease is also considered as an underlying condition for arteria lusoria, none of the patients in the current study had history of aortic valve disease (18).

The main aim of present study was the evaluation of two different catheters for performing a successful trans-brachial angiography with minimum complications and without changing the catheterization protocol to femoral approach in cases with acute angle in brachiocephalic trunk and subclavian artery. Our experience revealed that the success rate for coronary angiography was highest in AML2 catheter compared to the commonly used Judkins. This finding was also in line with the findings of the previous studies that reported a better success with AML catheter in case of anomalous vessels (21-24). Although the success rate for right and left Judkins catheters in non-anomalous patients were previously reported to range from 50-94% and 61-87% respectively (24), the success rate of Judkins catheter was 66.7% in the current study. A recent study which has evaluated the angiography results of tortuous subclavian artery has revealed valuable results. They have considered a severe tortuosity of right subclavian artery as if a third stiff guide wire was required to support catheter passage with manipulation. They have used the stiff guidwire (Amplatz) if the catheter didn't advanced because of right subclavian tortusity or poor back up. Engagement of left and right coronary artery was performed by Judkins or Amplatz catheters over stiff guide wire. Patients with greater BMI, short stature and hypertension tend to have sever tortuosity (11). In other studies which have evaluated other abnormalities of subclavian artery such as arteria losaria, other catheters are also used. In a study on 6 patients with arteria lusoria in right transradial coronary angiography, AML catheter was used successfully. The mean duration of the procedure was reported to be 47.4 minutes which was significantly higher than 12 to 13 minutes in transfemoral approach (23). Changing the approach to trans-femoral approach might result in decreased risk of thromboembolism by shortening the procedure time in the "pseudo lusoria" patients. Therefore in the current study transfemoral approach was chosen for 4 patients due to the elongation of fluoroscopy procedure time. Unfortunately, the procedure time in that study was recorded from the beginning to the end of procedure which was different from the current study, so the comparison of results wouldn't be beneficial.

To the best of our knowledge, no study has yet compared the use of AML with Judkins and other conventional catheters in performing coronary angiography with specific tortuous subclavian artery "pseudo losaria". However, due to the shape of the curve and ability to reach unusual high cusp origins in AML, this catheter is beneficial in some anomalous coronary vessels and abnormal arteries (22). The importance of choosing the best catheter is more highlighted when complications occur. By choosing the best catheter the complications can be reduced. The current study two cases of CVA were identified which could be indicative of prolonged fluoroscopy procedure. It was previously shown that increased duration of catheterization may result in embolism in other organs (25). So, reducing the procedure time in anomalous vessels by choosing the best catheter will be the best way to reduce the complications resulted by artery manipulations and radiation exposure during coronary angiography for both patients and physicians.

This study revealed that the AML catheter might be a choice in performing right trans-radial coronary angiography in patients with "pseudo lusoria". Therefore, the risk of changing the trans-radial approach to femoral approach will be reduced and further complication of femoral approach. Also, by choosing the

ISSN: 0975-3583, 0976-2833 VOL13, ISSUE05, 2022

best catheter, the radiation exposure for both patients and physicians will be reduced and manipulation of the vessels will be minimized.

One of the limitations of this study was the sample size. As stated in the methodology, this study served as a pilot study for comparison of success in trans-radial coronary angiography using AML and Judkins. Therefore, the findings of this study may not be generalizable to the whole population and further studies on larger samples should be conducted in order to provide evidence for using AML in "pseudo lusoria".

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Conflict of interest:

None declared.

Authors' Contributions:

Mostafa Ahmadi and Arash Khamenh Bagheri contributed to the conception or design of the work. Laya Valaee and Yalda Ravanshad contributed to the acquisition, analysis, or interpretation of data for the work. Laya Valaee and Yalda Ravanshad and Amirhossein Rafighdoust drafted the manuscript. Mostafa Ahmadi critically revised the manuscript. All gave final approval and agree to be accountable for all aspects of work ensuring integrity and accuracy.

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ISSN: 0975-3583, 0976-2833 VOL13, ISSUE05, 2022

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Figures legends:
Figure 1. The schematic figure of "pseudo losaria" which is defined as a short angle between brachiocephalic artery and subclavian artery (< 70^0) during angiography (B) and short angle (<90^0) between aorta and brachiocephalic trunk. Figure A shows the normal appearance of arteries. AO: Aorta. SA: Subclavian artery, BCT: Brachiocephalic trunk.

Tables:
Table 1. Description and comparison of demographic characteristics among patients

		Total patients N=47
		Frequency (%)
Gender	Male	25 (53.2%)
	Female	22 (46.8%)
Dx	MI	15 (31.9%)
	Unstable Angina	13 (27.7%)
	Stable Angina	19 (40.4%)
Addiction		14 (29.8%)
Smoking		18 (38.3%)
HLP		14 (29.8%)
CVA		2 (4.3%)
DM		22 (46.8%)
HTN		37 (78.7%)
IHD		13 (27.7%)

Dx= Diagnosis, MI=Myocardial infarction, HLP= Hyperlipidemia, CVA= Cerebrovascular accident, DM= Diabetes Mellitus, HTN= Hypertension, IHD= Ischemic heart disease
ǂ The Fisher exact test was used for comparison. For the rest of variables the chi-squared test was used for comparison.
Table 2. Description and comparison of echocardiographic variables among study groups

0		AML2 n= 24 Frequency (%)	Judkins n= 23 Frequency (%)	P value
Electrocardiography	Normal	6 (25.0%)	6 (26.1%)	0.96
	ST elevation	10 (41.7%)	9 (39.1%)	

ISSN: 0975-3583, 0976-2833 VOL13, ISSUE05, 2022

		ST depression	4 (16.7%)	5 (21.7%)	
		LVH pattern	4 (16.7%)	3 (13.0%)	
Echocardiography	EF	Normal	8 (33.3%)	8 (34.8%)	0.98
		Mild Reduction	6 (25.0%)	6 (26.1%)	
		Moderate Reduction	3 (12.5%)	2 (8.7%)	
		Severe Reduction	7 (29.2%)	7 (30.4%)	
	AV	Normal	11 (45.8%)	10 (43.5%)	0.89
		Mild AI	10 (41.7%)	9 (39.1%)	
		Moderate AI	3 (12.5%)	4 (17.4%)	
		Severe AI	0	0	
	MV	Normal	4 (16.7%)	5 (21.7%)	0.65
		Mild MR	14 (58.3%)	15 (65.2%)	
		Moderate MR	5 (20.8%)	3 (13.0%)	
		Severe MR	1 (4.2%)	0 (0.0%)	
	TV	Normal	10 (41.7%)	12 (52.2%)	0.77
		Mild TR	10 (41.7%)	8 (34.8%)	
		Moderate TR	4 (16.7%)	3 (13.0%)	
		Sever TR	0	0	
	Aortic root size	Normal	16 (66.7%)	16 (66.6%)	0.83
		Dilated	8 (33.3%)	7 (30.4%)	
Fluoroscopy time (s)		<120	20 (83.4%)	8 (34.8%)	<0.001
		>120	4 (16.6%)	15 (65.2%)	
		Overall	10.05±4.14	16.00±2.62	0.001

EF= Ejection fraction, LV= Left ventricle, RV= Right ventricle, RWMA= Regional wall motion abnormality, AV= Aortic valve, MV= Mitral valve, TV= Tricuspid valve, s= second
** Significant at α=0.01
Table 3. Description and comparison of successful and unsuccessful angiography cases in both groups.

			AML2	Judkins	P value
Results	Successful (<120 s)	Count	20	8	0.001
		% within Unsuccessful	71.4%	28.6%	
	Unsuccessful (> 120 s)	Count	4	15	
		% within Unsuccessful	21.1%	78.9%	

s= second

Table 4. Description and comparison of complications in both groups.

			AML2	Judkins	P value
complications	None	Count	24	21	0.23

ISSN: 0975-3583, 0976-2833 VOL13, ISSUE05, 2022

		% within none complications	53.3%	46.7%	
	CVA	Count	0	2	
		% within complications	0%	100%	

CVA: cerebrovascular accident

Figure 1