ORIGINAL ARTICLE

FREQUENCY AND PREDICTORS OF RADIAL ARTERY SPASM DURING CORONARY ANGIOGRAPHY/PERCUTANEOUS CORONARY INTERVENTION

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Background: Coronary angiography is the gold standard test for diagnosis coronary artery disease. It can be performed via various intra-arterial routes, i.e., femoral, radial, brachial, ulnar, or axillary arteries. Trans-Radial access for coronary angiography is a good approach with less major vascular complications, increased patient comfort and early mobilization and less hospital stay but is associated with radial artery spasm as the major complication affecting the success of the procedure. **Methods:** This study was a descriptive cross-sectional study. It enrolled one hundred and thirty-six (136) consecutive patients who underwent the procedure of coronary angiography/PCI over a 6-month period. The study included both in and outpatients undergoing coronary angiography/PCI. Coronary angiography/Percutaneous coronary intervention was done via trans radial approach and the study participants were observed for development of radial artery spasm using clinical and angiographic parameters. Data was entered and analysed using SPSS-19. **Results:** The frequency of radial artery spasm was 13.24% (n=18). Radial artery spasm was statistically significant in females (p<0.05), those who had severe pain during radial artery puncture (p<0.001) and those who had unsuccessful first attempt during radial artery puncture (p<0.001). No statistically significant association was found between radial artery spasm and other predictors such as age, hypertension and diabetes mellitus. **Conclusion:** Radial artery spasm is a common complication during trans radial approach for coronary angiography/percutaneous coronary intervention particularly in females, those who have unsuccessful first attempt and those who have severe pain during radial artery puncture.

Keywords: Coronary angiography; PCI; Radial artery spasm

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INTRODUCTION

Coronary angiography is the gold standard method for diagnosis of atherosclerotic cardiovascular disease. It can be performed via various routes, i.e., femoral, radial, ulnar, brachial and axillary artery. Since advent of this procedure, femoral route has remained one of the most favourite routes of operators but complications such as hematoma, bleeding, AV malformation, pseudoaneurysm and prolonged immobility are quite common after this approach.[1–4]

Trans-radial approach has many advantages as compared to femoral route and it is now being increasingly used for coronary angiography and angioplasty due to lesser incidence of vascular complications.[5–7]

There are some disadvantages of trans-radial approach, most commonly being prolonged learning curve resulting in increased incidence of radial artery spasm and exposure to radiation. Radial artery is a type III artery, thereby predisposing it to increased incidence of spasm as compared to other arteries.[8] Type III arteries are typically limb arteries which release less nitric oxide (NO) and are more prone to spasm as compared to Type I somatic arteries, i.e., left internal mammary artery (LIMA).

Development of radial artery spasm during the procedure has multitude of effects. It increases the procedure time, discomfort of patient and overall effects the procedural success.

MATERIAL AND METHODS

This study was a descriptive cross-sectional study. It enrolled one hundred and thirty-six (136) consecutive patients who underwent the procedure of coronary angiography / PCI over a 6-month period. The study included both in and outpatients undergoing coronary angiography/PCI. Coronary angiography / percutaneous coronary intervention were done via trans radial approach and the study participants were observed for development of radial artery spasm using clinical and angiographic parameters. Data was entered and analysed using SPSS.

Radial artery spasm was defined as clinical radial artery spasm (RAS) and angiographic radial artery spasm (RAS).

Clinical RAS was defined as presence of ≥2 (two) of the following 5 (five) factors:

1. Persistent pain in the forearm
2. Pain response to catheter manipulation
3. Pain response to sheath withdrawal
4. Difficult catheter manipulation after trapped by radial artery
5. Resistance on withdrawal of sheath

Multivariate logistic regression analysis was performed to identify independent predictors of RAS, including variables that have an effect at the beginning of the procedure (sex, age, presence of hypertension, diabetes mellitus, and smoking, pain intensity on puncture and success on first attempt). Pain intensity was assessed and categorized using numeric pain rating scale from 0–10 into painless, mild, moderate and severe pain.

0-painless
1–3 mild pain
4–6 moderate pain
7–10 severe pain

A *p*-value of <0.05 was considered statistically significant.

RESULTS

In our study the total number of patients enrolled were 136. The minimum age of patient was 26 and maximum was 80 with mean age of 53.94 and standard deviation of 10.29.

Out of these 136 patients, female patients were 40 (29.41%) and male were 96(%). Out of these 136 patients, radial artery spasm occurred in 18 patients with frequency of 13.24%.

There was significant difference between males and females in terms of spasm. Out of 40 female patients,09 (22.5%) had spasm. Out of 96 male patients, 09 (9.3%) had spasm. So in terms of spasm, significant difference was observed with *p*-value of (0.04).

Pain intensity during needle puncture was analysed using pain score into painless, mild, moderate and severe pain. Out of total 136 patients, 23 patients had painless radial artery puncture. Eighty-seven patients had mild pain, 15 patients had moderate and 11 patients had severe pain. In the patients in painless group only 01 (4.3%) had spasm. In mild pain group, 01 (1.1%) had spasm. In moderate pain group, 15 (33.3%) had spasm and in severe pain group, 11 (54.5%) patients had radial artery spasm.

So radial artery spasm was significant ($p<0.001$) in those patients who had severe pain during radial artery puncture.

We also analysed correlation between successes at first attempt in radial artery puncture with unsuccessful first attempt with radial artery spasm. Out of 136 patients, 112 (82.35%) had success at first attempt while 24 (17.64%) were unsuccessful at first attempt.

Out of 112 patients who had success at first attempt, 5 (4.5%) developed spasm whereas out of 24 patients who had unsuccessful first attempt, 08 (33.3%) developed spasm.

Incidence of radial artery spasm was statistically significant ($p<0.001$) in patient.

Other factors such as hypertension, diabetes mellitus and smoking didn't have any significance in terms of radial artery spasm.

As a result, factors such as female gender, pain intensity during needle puncture and success at first attempt during radial artery puncture had statistically significant correlation with radial artery spasm during coronary angiography and percutaneous coronary intervention.

DISCUSSION

Coronary angiography and percutaneous coronary intervention is an effective way to deal with atherosclerotic cardiovascular disease. Since its inception, procedural techniques of coronary angiography and PCI have evolved. Coronary angiography in its early years was conventionally performed via transfemoral route however with time other routes were introduced in the practice. Out of them, trans-radial route has gained a lot of significance. This was backed by a large number of clinical trials which showed trans-radial approach to be safe and with obvious advantages as compared to transfemoral route.[9]

Radial artery is a thin artery and is controlled by alpha adrenergic nerves. Due to this fact, radial artery is prone to spasm which ultimately contributes to procedural complexity and failure.[10] Radial artery spasm is a complication of trans-radial approach and can affect the procedure at various stages. If it occurs at the beginning of procedure, it prevents the passage of exchange wire and causes immense pain and anxiety in the patient. If it occurs at the middle of procedure, it causes difficult catheter manipulation and difficulty in catheter engagement, thereby increasing both the fluoroscopy and procedure time. If it occurs at the end of procedure, it can cause difficult catheter and sheath withdrawal. Due to intense pain, it can also provoke vasovagal reaction in the patient, which in some cases, can be difficult to manage. Overall radial artery spasm during trans-radial approach, can lead to procedure prolongation and failure.

According to the literature review till now, incidence of radial artery spasm depends on various factors. It mainly depends on experience of operator but in experienced hands and large volume centres,

incidence of radial artery spasm has been reported between 15–30%.[11]

Development of radial artery spasm is also related to small diameter of radial artery and its enhanced vasoreactivity.[12] Unsuccessful first attempt during radial artery cannulation and multiple attempts for radial artery cannulation can also lead to radial artery spasm due to its muscular nature.[13,14]

In our study, frequency of radial artery spasm was 13.24%. Radial artery cannulation was done by both cardiology fellows rotating in the cardiac catheterization laboratory and consultants. In our study we considered various factors effecting radial artery spasm in literature. Those factors which were considered for our study were gender, history of hypertension, smoking and diabetes. Other factors were success on first attempt, severity of pain while cannulating the radial artery and primary diagnosis of the patient at the start of procedure.

In our study, we concluded that female gender, unsuccessful first attempt during radial artery cannulation and severe pain during radial artery cannulation, increased the incidence of radial artery spasm (RAS).

AUTHORS' CONTRIBUTION

MK: Literature search, Proof reading. MYD: Study design, data collection, analysis. MSA, MIK, HK: Data collection, proof reading. MAY: Data collection, data analysis, write-up

REFERENCES

1. Cooper CJ, El-Shiekh RA, Cohen DJ, Blaesing L, Burket MW, Basu A, *et al*. Effect of transradial access on quality of life and cost of cardiac catheterization: A randomized comparison. Am Heart J 1999;138(3 Pt 1):430–6.
2. Mann T, Cubeddu G, Bowen J, Schneider JE, Arrowood M, Newman WN, *et al*. Stenting in acute coronary syndromes: A comparison of radial versus femoral access sites. J Am Coll Cardiol 1998;32(3):572–6.
3. Kiemeneij F, Hofland J, Laarman GJ, van der Elst DH, van der Lubbe H. Cost comparison between two modes of Palmaz Schatz coronary stent implantation: Transradial bare stent technique vs. transfemoral sheath-protected stent technique. Cathet Cardiovasc Diagn 1995;35(4):301–8.
4. Choussat R, Black A, Bossi I, Fajadet J, Marco J. Vascular complications and clinical outcome after coronary angioplasty with platelet IIb/IIIa receptor blockade. Comparison of transradial vs transfemoral arterial access. Eur Heart J 2000;21(8):662–7.
5. Caputo RP, Tremmel JA, Rao S, Gilchrist IC, Pyne C, Pancholy S, *et al*. Transra-dial arterial access for coronary and peripheral procedures: Executive summary by the Transradial Committee of the SCAI. Catheter Cardiovasc Interv 2011;78(6):823–39.
6. Hamon M, Pristipinoc, Di Mario C, Nolan J, Ludwig J, Tubaro M, *et al*. Con-sensus document on the radial approach in percutaneous cardiovascular interventions: Position paper by the Euro-pean Association of Percutaneous Cardiovascular Inter-ventions and Working Groups on Acute Cardiac Care and Thrombosis of the European Society of Cardiology. Eurointervention 2013;8(11):1242–51.
7. Gorgulu S, Norgaz T, Karaahmet T, Dagdelen S. Incidence and predictors of radial artery spasm at the beginning of a transradial coronary procedure. J Interv Cardiol 2013;26(2):208–13.
8. He GW, Yang CQ. Comparison among arterial grafts and coronary artery. An attempt at functional clas-sification. J Thorac Cardiovasc Surg 1995;109(4):707–15.
9. Kiemeneij F, Laarman GJ, Odekerken D, Slagboom T, van der Wieken R. A randomized comparison of percutaneous transluminal coronary angioplasty by the radial, brachial and femoral approaches: the access study. J Am Coll Cardiol 1997;29(6):1269–75.
10. Goldberg SL, Renslo R, Sinow R, French WJ. Learning curve in the use of the radial artery as vascular access in the performance of percutaneous transluminal coronary angioplasty. Cathet Cardiovasc Diagn 1998;44(2):147–52.
11. Kiemeneij F, Vajifdar BU, Eccleshall SC, Laarman G, Slagboom T, Wieken RV. Evaluation of a spasmolytic cocktail to prevent radial artery spasm during coronary procedures. Cathet Cardiovasc Intervent 2003;58(3):281–4.
12. Chardigny C, Jebra VA, Acar C, Descombes JJ, Verbeuren TJ, Carpentier A, *et al*. Vasoreactivity of the radial artery. Comparison with the internal mammary and gastroepiploic arteries with implications for coronary artery surgery. Circulation 1993;88(5 Pt 2):II115–27.
13. Kotowycz MA, Džavík V. Radial artery patency after transradial catherization Circulation. Cardiovasc Interven 2012;5(1):127–33.
14. Jia DA, Zhou YJ, Shi DM, Liu YY, Wang JL, Liu XL, *et al*. Incidence and predictors of radial artery spasm during transradial coronary angiography and intervention. China J Med 2010;123(7):843–7.

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