Retrospective Study of Success Rate of Right Radial Artery Access for Coronary Angiography in a Cardiac Catheterization Laboratory with Operators Inexperienced in Radial Access

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ABSTRACT

BACKGROUND
Coronary angiography (CAG) is the most common procedure done in a cardiac catheterization lab (cathlab). In the last decade, the preferred access has changed to radial from femoral artery. CAG via radial route is believed to have a long learning curve. We wanted to assess the success rate of right radial route for CAG and its improvement over one year for operators inexperienced with the radial route.

METHODS
A retrospective study over one-year period from June 1, 2017 to 31 May 2018 involving 1011 CAGs was done. First 150 CAGs were compared with 150 CAGs done at end of first year. Demographic variables of patients, arterial access for CAG, fluoroscopy time, number of cine angios recorded and radiation dose of cine-recording were compared. Qualitative data was analysed using Chi Square test, quantitative data using independent t test and correlation done using Pearson correlation.

RESULTS
Demographic variables were comparable between the two groups. CAG was completed successfully in 88.7% (133/150) via right radial artery in first group and in 92.7% (139/150) in second group (p<0.05). There was significant reduction of 1.8 minutes in mean fluoroscopy time between the two groups (6.5 vs. 4.7 minutes p<0.001). A positive correlation was noted between total radiation dose and number of cine films recorded in both groups.

CONCLUSIONS
CAG via right radial route can be done with good success rate even by inexperienced operators. The success rate improves, and fluoroscopic time decreases over time. By reducing the number of cine recordings total radiation dose can be brought down.

KEYWORDS
Coronary Angiography, Femoral Access, Radial Access, Fluoroscopy Time, Radiation Dose

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BACKGROUND

The procedure patterns in cardiac catheterization laboratory (cath lab) have been changing over the years in a slow and steady manner. A major change has been in the arterial access for procedures. Femoral artery was considered the traditional vascular access for coronary angiography. Transradial coronary angiography was introduced by Campeau et al. in 1989¹ and transradial coronary angioplasty and stenting by Kiemeneij et al in 1993.² Radial access decreased the net adverse clinical events by decreasing the incidence of major bleeding and all-cause mortality as shown in the multicentre randomized trial MATRIX (Minimizing Adverse Haemorrhagic Events by Transradial Access Site and Systemic Implementation of Angiox).³

Increasing number of interventional cardiologists has started doing procedures through the radial artery. An important aspect in the modern catheterization laboratory is the training of new operators. Experienced operators started to work with femoral access but are changing to radial access. Nowadays, cardiology fellows start their training directly with radial access, which is the first choice of access site in almost all catheterization laboratories, without the background of femoral access. Operators with no experience in vascular access often lead to an increase in the incidence of access failure and vascular complications.⁴ On the other hand, operators with experience in femoral access may easily change over to radial access. After the inception of the first fully functional cath lab in Kerala in 1978, the number of cath labs in the state has steadily increased to more than a hundred.⁵ The change in procedure patterns is also occurring in our state but there is limited data on that.

In the U.S., it has been shown that there is an increasing adoption of transradial access for diagnostic procedures (from 6% to 36%)⁶ during 2009 to 2015. It is also found that increasing operator transradial experience is associated with lower odds of cannulation failure and transfemoral cross-over, as well as lower contrast medium dose and fluoroscopy time.⁷ The learning curve in transradial procedures has also been evaluated.⁸ It is found that high volume operators had 1.88 and 3.66 minute reductions in fluoroscopy time compared to the intermediate and low volume operators respectively. The improvement in fluoroscopy time and other procedure-related parameters was seen after approximately 25 cases with further improvement after 75 cases. Lower-volume operators have a reduction in procedure related parameters with increase in the number radial cases done by them. It has also been shown that a high success rate can be achieved early in the operator learning curve. The success rate for cardiac catheterization via the radial approach for beginners was 97.4% in one study.⁹

A cath lab was set up for the first time in our hospital in 2017. There were four operators doing CAG. All were trained in femoral access, while three had little experience in radial access. We did a retrospective study to assess whether there was any change in the procedure patterns in the first year of setting up of cath lab with such a group of operators. The study was done to find out areas where changes could be made so as to improve the procedure pattern and to reduce radiation hazard.

We wanted to assess the success rate of completing coronary angiography via the right radial route in the beginning, assess the improvement in the technique as experience mounted and assess the changes in fluoroscopy time and amount of radiation over a period of one year.

METHODS

The study was conducted in the department of cardiology of Government Medical College Hospital, Thrissur, Kerala after approval from institutional ethics committee (Letter no. B6-8772/2016/MCTCR(7) dated 29/09/2018). This was a retrospective analysis of coronary angiograms done in the first one year of inception of cath lab in our centre (from June 1st 2017 to May 31st 2018). There were four operators doing CAGs. All had experience in doing CAG via femoral route. Three had no experience in radial access while one was well experienced in that.

Exclusion Criteria

1. CAGs done by the operator experienced in the radial route.
2. All patients where right sided radial access was considered not possible on pre CAG evaluation. (Prior to CAG all patients underwent the Barbeau test to assess adequacy of palmar arch flow and only if adequate, radial access was selected. If the D type of response to the procedure was documented radial access for the procedure was deemed contraindicated.¹⁰¹¹)
3. Cases with right upper limb deformity so that limb could not be positioned properly on the table.
4. Cases which were taken up for adhoc intervention as the fluoro time would increase because of the intervention.

For collection of data two groups were chosen after exclusion- 150 coronary angiograms done at the beginning of the first year and 150 coronary angiograms done at the end of the first year. Clinical details of the patient were collected from their case records and procedure details from the angiographic data stored in the cath lab. The details of each patient noted included age, sex, height in meters, weight in kilograms, BMI, clinical diagnosis and coronary risk factors. The coronary risk factors recorded in the case sheet viz. Hypertension, diabetes mellitus, dyslipidaemia, smoking, cerebrovascular accident, and family history of coronary artery disease were noted. Procedure details included the operator who did the case, the arterial access through which CAG was done, fluoroscopy time in seconds, cine-recording time in seconds, total radiation dose in mGy, radiation dose during cine recording in mGy and the final angiographic diagnosis. Crossover from the right radial to the femoral or alternative site was done at the discretion of the operator.
Radial sheaths used were of 6F and were manufactured by Terumo Corporation, Japan. After the insertion of the sheath, nitro-glycerine (200 microgram) mixed with unfractionated heparin (70 IU/Kg) was given for all patients. 5F Tiger catheter was used along with hydrophilic guide wires for coronary angiography. The number of cine films recorded was at the discretion of the operator. Arterial sheaths were removed immediately after coronary angiography and local haemostasis was achieved using a pressure bandage to occlude the site of puncture, which was removed the next morning. Complications related to access site were noted.

Data was coded and entered in excel sheet and analysed. Statistical analysis was done using SPSS software. Qualitative data was analysed using Chi Square test. Quantitative data (means) was analysed using independent t test. Correlation was done using Pearson correlation. Significance level was kept at 5%.

RESULTS

1011 coronary angiograms were done in the first one year of starting the cath lab from 1st June 2017 to 31st May 2018. In this period after applying the exclusion criteria, the first 150 coronary angiograms were taken as group I and the last 150 coronary angiograms were taken as group II. Baseline characters were similar in both the groups. Mean age was 55 years, two thirds being males. The average height was 1.58 metres and weight 69 kg. 25% had hypertension, 31% had diabetes and 27% were smokers. The baseline characteristics of both groups are given in table 1.

Right radial artery was the initial access attempted in all cases. Coronary angiography was completed via right radial route in 88.7% cases in group I and 92.7% in group II. In group I right radial access had to be changed to left radial access in 4% cases and right femoral access in 7.3% cases. In group II change to left radial was 0% and right femoral was 7.3% cases. Left femoral artery was not used as an alternate access in both the groups. The details of the access through which coronary angiography was completed is given in table 2.

The mean fluoro time for right radial access in group I patients was 6.5±1.7 minutes while in group II patients it was 4.7±1.5 minutes. As all cases started with right radial puncture and were later changed to alternate access and as the fluoroscopy time was recorded for the whole procedure a separate analysis of fluoroscopy times of alternate accesses could not be done. As expected, the total fluoro time was higher in alternate accesses; the fluoro time where right radial was changed to right femoral for completing CAG was 7.6 mins and when changeover was to left radial it was 7.6 mins. Average number of cine exposures for recording the pictures in the two groups were 8.14 and 8.18, while the time of cine recording was 37.8 and 38.09 seconds. The procedural characteristics of patients are given in table 3.

The mean radiation dose for a case as measured in the machine was 204.81 mGY in group I while it was 202.44 mGY in group II. There was no difference between the two groups. However, a positive correlation of mean radiation dose was seen with the number of exposures in both the groups. (Figure 1)

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Group I</th>
<th>Group II</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age(years)</td>
<td>55.3 ± 8.5</td>
<td>55.7±9.4</td>
<td>0.66</td>
</tr>
<tr>
<td>Male</td>
<td>62.7%</td>
<td>67.3%</td>
<td>0.39</td>
</tr>
<tr>
<td>Female</td>
<td>37.3%</td>
<td>32.7%</td>
<td>0.12</td>
</tr>
<tr>
<td>Height (metres)</td>
<td>1.58</td>
<td>1.59</td>
<td>0.87</td>
</tr>
<tr>
<td>Weight(kg)</td>
<td>60.23</td>
<td>58.75</td>
<td>0.67</td>
</tr>
<tr>
<td>Hypertension</td>
<td>24%</td>
<td>27%</td>
<td>0.23</td>
</tr>
<tr>
<td>Diabetes</td>
<td>31%</td>
<td>32%</td>
<td>0.66</td>
</tr>
<tr>
<td>Smoking</td>
<td>28%</td>
<td>26.5%</td>
<td>0.56</td>
</tr>
</tbody>
</table>

Table 1. Baseline Characteristics of Patients

<table>
<thead>
<tr>
<th>Access</th>
<th>Group I - Inexperienced Operators (150)</th>
<th>Group II - Experienced Operators (150)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right radial</td>
<td>133(88.7%)</td>
<td>139(92.7%)</td>
</tr>
<tr>
<td>Left radial</td>
<td>6(4%)</td>
<td>0</td>
</tr>
<tr>
<td>Right femoral</td>
<td>11(7.3%)</td>
<td>11(7.3%)</td>
</tr>
<tr>
<td>Left femoral</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 2. Access for Coronary Angiography

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Group I</th>
<th>Group II</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluoro time(minutes)</td>
<td>6.5</td>
<td>4.7</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Cine Exposure(number)</td>
<td>8.14</td>
<td>8.18</td>
<td>0.77</td>
</tr>
<tr>
<td>Cine Time(seconds)</td>
<td>37.8 ± 11.8</td>
<td>38.09 ± 10.7</td>
<td>0.71</td>
</tr>
</tbody>
</table>

Table 3. Procedural Characteristics of Patients

DISCUSSION

The patient demographic profile was similar between the two groups. Coronary angiography via right radial route was successful in majority of patients in both the groups. In group I, 88.7% had coronary angiography via radial route. By the end of the first year it rose to 92.7% and the difference was statistically significant. Looi JL et al in a study similar to ours analysed the data of 1001 patients for diagnostic angiography without ad hoc intervention over a 12-month period comparing transradial (TR) to transfemoral (TF) procedural and fluoroscopic times, contrast volume, and complication rates. All TF procedures were successful and 92% were successful for TR angiography.
Radial artery access is a successful and safe route for the performance of coronary angiography. The safety is partly decided by the adequacy of palmar collateral circulation which can be assessed by Allen’s test. It has been found that by using the Barbeau modification of Allen’s test, the safety outcomes can be improved. For all cases we routinely used the Barbeau test prior to angiography and excluded those cases with D type response. There were no complications of gangrene or loss of palmar circulation after the procedure in any of our cases.

Right radial artery is chosen as a default access in all cath labs except in selected cases. In the initial learning phase of operator experience cross over to an alternate site from right radial access can be common. It has been seen in 12 to 24% of patients especially during the learning curve. In the initial phase we had to cross over in 11.3% of cases which is slightly less when compared to other studies. The reason could be that all operators in our centre were quite proficient in vascular access via femoral route before they started attempting radial access.

The radial artery is a medium sized artery with a thick coat of muscle within the tunica media. In the initial phase of radial artery catheterization there can be excessive instrumentation by the operator in accessing radial artery as well as in the subsequent performance of the angiogram which leads to spasm of the vessel. As experience increases this tendency decreases and hence vasospasm also decreases. With experience the technique to manipulate the catheter improves even in presence of initial transient vasospasm so that procedural success can increase. This could be the reason for rise in radial access success rate to 92.7% by end of one year.

Even for experienced operators, anatomical obstructions to the passage of the catheter remain a persistent cause of access site crossovers. The excessive tortuosity in the brachiocephalic and the subclavian arteries can also lead to access site crossovers. Even at the end of one year we had to use femoral access in 7.3% of cases probably because of such reasons. As it was a retrospective study a separate analysis of such reasons could not be done.

The mean fluoroscopy time was 6.5 minutes in group I and 4.8 minutes in group II. There have been studies regarding fluoro time and operator experience. In the study by Looi et al, the mean fluoroscopy time for inexperienced operators was 8 minutes while for experienced operators it was 4.4 minutes in the beginning. In this study over a period of one year the fluoro time of inexperienced operators came down to 5.2 minutes while that of experienced operators remained at 4.5 minutes. In another study by Balwanz et al the value for inexperienced operators was 10.4±6.0 minutes. Our study showed less fluoro time even at the beginning because of operator’s previous experience in coronary angiography via femoral route. Experienced operators take lesser time in becoming proficient in radial artery access route as evidenced by lesser fluoroscopy times even during the learning curve.

CONCLUSIONS

The initial success rate of doing coronary angiography via the radial route is high and it further improves with time. So, a fear of failure should not limit the use of this route for the beginners. The mean fluoroscopy time decreases with experience amounting to a reduction in radiation exposure. Therefore, right radial access can be adopted as the default route for performance of diagnostic coronary artery procedures. The positive correlation noted of mean radiation dose to the number of cine exposures in both the groups suggests that by limiting cine exposures to the minimum, total radiation dose can be reduced.

REFERENCES


