Abnormal origin of right coronary artery and use of Tiger catheter through femoral route

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ABSTRACT

Background: Abnormal origin of right coronary artery (RCA) is not uncommon. The incidence is .25–.92%. Right Judkin catheter is used universally for engaging right coronary ostium from femoral route. We have tried Tiger catheter from femoral route in abnormal origin of RCA patients. We were successful in cannulating RCA ostium in most of the cases.

Materials and methods: We have studied about 5120 patients over 4 years. We have selected patients from November 2010 to November 2014. Our patients are from two institutions—I.P. G.M.E.R., Kolkata and Burdwan Medical College, West Bengal. Right Judkin 3.5 and 4 were used universally. We have used AL-1,2,3, AR1,2, multipurpose, different guide catheters for cannulating RCA ostium in those cases where we failed to engage by right Judkin catheter. We have used Tiger catheter as a last resort when all endeavor failed.

Results and analysis: Among 40 cases of left sinus origin Type A—9, Type B—14, Type C—6, Type D—3, and Type E—8 patients were observed. But 668 cases abnormal origin of RCA were from right coronary sinus only. High take-off origin were 422 cases (8%), low take-off were 132 cases (2.5%), and posterior origin were 114 cases (2%). We could engage right coronary ostium by Tiger catheter in 690 cases (97%). We failed in 23 cases (3%).

Conclusion: Tiger catheter can be used successfully in abnormal RCA origin cases. It is more effective but less risky in comparison to other catheters.

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1. Introduction

The incidence of anomalous origin of coronary arteries varies from .03% to 5.64%. Separate origin of left anterior descending (LAD) and left circumflex artery (LCX) is the commonest. Abnormal origin of right coronary artery (RCA) is not uncommon. The incidence is .25–.92%. Anomalous origin of arteries can cause dyspnea, palpitation, angina, dizziness, and syncope. It may even lead to sudden death during exertion. Abnormal origin of RCA is usually from right coronary sinus. Sarkar et al. 1 had experienced abnormal origin of RCA about 20% of their patients. Right Judkin catheter is used universally for engaging right coronary ostium from femoral route. Different catheters are used for cannulating RCA ostium in abnormal origin cases. These catheters could be Amplatz left (AL-1,2,3), Amplatz right (AR-1,2), Judkin left (JL), left and right extra backup guide catheter (left EBU and right EBU), Voda,
2. Materials and methods

We have studied about 5120 patients over 4 years. We have selected patients from January 2011 to December 2014. Our patients are from two institutions—I.P.G.M.E.R., Kolkata and Burdwan Medical College, West Bengal. Both are tertiary medical centers and Govt. medical colleges. For coronary angiography, we have taken patients with ST segment elevation myocardial infarction with post-infarct angina, non-ST segment elevated myocardial infarction, and high-risk stable angina (Treadmill test positive at <5 METs). Few of them have undergone angioplasty and stenting in the same period and some at later date. Our objective was to study abnormal RCA origin cases. Right Judkin 3.5 and 4 were used universally. We have used AL-1,2,3, AR1,2, multipurpose, different guide catheters for cannulating RCA ostium in those cases where we failed to engage by right Judkin catheter. We have used Tiger catheter as a last resort when all endeavors failed.

2.1. Statistical analysis

We have analyzed categorical variables in percentage and used chi-square test to assess significance of our data.

3. Results and analysis

In the years 2011 and 2012, we have used Tiger catheter when all other catheters failed. But from 2013 to 2014, we have used Tiger catheter when right Judkin catheter failed. We have seen abnormal origin in 714 cases (14%). RCA origin from left coronary sinus was in 40 cases (.8%). In 6 patients (.1%), RCA origin was from non-coronary sinus. Among 40 cases of left sinus origin, Type A—9 patients, Type B—14 patients, Type C—6 patients, and Type D—3 patients were observed. We have seen RCA originating from opposite half of left sinus in 8 cases. We named it Type E. But 668 cases abnormal origin of RCA were from right coronary sinus only. High take-off origin was 422 cases (8%), low take-off was 132 cases (2.5%), and posterior origin was 114 cases (2%) (Fig. 1a). We could engage right coronary ostium by Tiger catheter in 690 cases (97%). We failed in 23 cases (3%). We have to use pigtail catheter in those failed cases. We have failed in 18 cases of posterior origin, 4 cases of RCA originating from opposite half of left sinus (Type E), and one case of Type D. We were successful in all cases of high take-off, low take-off, non-coronary sinus origin, and other cases of left sinus origin (Tables 1–4).

4. Discussion

Coronary catheters have five parts—hub, shaft, secondary curve, primary curve, and tip. Guide catheter in comparison to diagnostic catheter have three braded layers causing more stiffness, larger internal diameter, and short, more angulated
(110°/90°) and non-tapering tip (Fig. 1b). Kiemeneij et al. popularized the idea of using Tiger catheter for radial angiography. Tiger catheter is used for both right and left coronary systems. Our experience of radial angiography has shown that we were successful in cannulating RCA ostium in all cases, but we failed to engage left coronary system in few cases. This gave us the idea of using Tiger catheter through femoral route in abnormal RCA origin cases. Abnormal origin of RCA could be from left coronary sinus or from right coronary sinus. We have seen RCA originating from non-coronary sinus in few patients (Fig. 1c). We were able to cannulate three cases of abnormal origin from above sinus of Valsalva also (Fig. 1d). Choice of catheters depends upon origin, angulation, height, shape of RCA as well as aortic diameter, and antero-posterior orientation of aorta. According to angulation, RCA origin can be divided into four types:

Type 1 90° angle from aorta;
Type 2 less than 90° angle from aorta;
Type 3 greater than 90° angle from aorta; and
Type 4 anomalous or ectopic origin.

Judkin catheter is ideal for Type 1. Amplatz catheter is helpful in Type 2, and multipurpose catheter is useful in Type 3 origin. For Type 4, no specific catheter is useful and one has to resort to many catheters to cannulate these difficult RCA origin cases. Those RCA, which are arising from left coronary sinus, have been classified into four types:

A origin above sino-tubular plane;
B origin below the ostium of left coronary artery;
C origin between sino-tubular plane and left coronary ostium; and
D origin along the midline.

We have named Type E—when origin is from opposite half of left coronary ostium. Sarkar et al. have used JL in Type A, FCL (femoral curved left) 3.3.5 for Type B, Voda left for Type C, and AL-1,2 for Type D. According to height of origin, there are three types:

a) Normal take-off: 1–1.5 cm from aortic valve;
b) High take-off: >1.5 cm from aortic valve; and
c) Low take-off: <1 cm from aortic valve.

Judkin catheter is useful in normal and low take-off origin. AL catheters are helpful in high take-off cases. There are no data regarding choice of catheter when RCA originates from left coronary sinus at 6 o’clock to 12 o’clock position but opposite to left coronary ostium. These are the most difficult cases. We have used EBU or AL catheter in few cases. But there are no universal catheters, which can be useful in all cases. At times, different catheter exchanges may cause spasm or dissection of RCA ostium. RCA ostial dissection in abnormal anatomy could be disastrous. We have tried Tiger catheter from femoral route in these cases.

Advantage of this catheter is that it can take different shapes by push, pull, torque, and rotation. Its tip is also very soft and there is less chance of dissection. As it is a French catheter, it may seat deep in RCA and cause dissection. One has to be careful about that. We have disected RCA ostium in one patient, and angioplasty and stenting was performed to save the patient. In contrast, we have experienced 6 cases of dissection when we used other catheters. RCA ostial spasm was also less significant in comparison to other catheters (4 versus 32, p < .01). These higher proportions of complications are possibly due to different catheter exchanges and Amplatz catheter. Most cases were performed by experienced operators to rule out selection bias. Our success rates were significantly higher in relation to other catheters in abnormal origin cases (97% versus 70%; p < .01). Selection of a guide catheter should be based on configuration of the ostium, dimensions of the aortic root, location of the origin, and type of the lesion. The selective engagement of anomalous RCA can be difficult and time consuming. Abnormal origin of RCA from aorta can cause slit-like orifice. Anomalous artery can take

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**Table 1** - Abnormal origin according to angulation.

| Type | No. of patients | Percentage (%) |
|------|----------------|----------------|
| 1    | 430            | 8              |
| 2    | 142            | 2.7            |
| 3    | 102            | 2              |
| 4    | 40             | 0.8            |

**Table 2** - RCA abnormal origin according to take-off.

| Type        | No. of cases | Percentage (%) |
|-------------|--------------|----------------|
| High take off  | 422          | 8              |
| Low take off  | 132          | 2.5            |
| Posterior    | 114          | 2              |

**Table 3** - RCA origin from left sinus.

| Type | No. of patients |
|------|----------------|
| A    | 9              |
| B    | 14             |
| C    | 6              |
| D    | 3              |
| E    | 8              |

**Table 4** - Complication rates.

| Total no. of patients (N) | Year 2011–2012 (all other catheters N = 2560) | Year 2013–2014 (Tiger catheter N = 2800) | p-Value |
|---------------------------|-----------------------------------------------|----------------------------------------|---------|
| Abnormal RCA origin patients | 340                                          | 374                                   | <.01    |
| No. of patients having spasm    | 32                                           | 4                                     | .146    |
| No. of patients having dissection | 6                                            | 1                                     | .146    |
| No. of successful engagement    | 238                                          | 362                                   | <.01    |
abnormal course or angulation making cannulation difficult. Guide catheter selection is important for percutaneous coronary intervention (PCI) point of view. Successful PCI of anomalous RCA depends on optimal guide catheter seating, backup support, and co-axial alignment. Sarkar et al. described JL 5 guide catheter for Type A and EBU 3.5 for Type B. FCL 3 or 3.5 can be used in Type A or B cases. AL will be useful in Type C cases. AL guide catheter is also helpful when RCA originates from midline of aortic wall irrespective of left or right aortic sinus. Amplatz guide catheter may be useful in cannulating posterior or high take-off RCA origin. Horizontal and low take-off origin of RCA can be hooked by Judkin right guide catheter. EBU right can also be used in high or horizontal take-off cases. We have tried Ikari guide catheter in engaging abnormal right coronary ostium successfully in few cases (preliminary study).

5. Conclusion

Abnormal origin of RCA is not uncommon. Tiger catheter is a safe and effective alternative catheter in those difficult patients. One can try it when all other catheters failed. We propose to use it when Judkin catheter fails rather than trying all other catheters.

5.1. Limitations

It is a retrospective study. Patients’ numbers are also less for an observational study. There may be few missing data. Cases were done mainly by experienced operator. There could be a selection bias, as it is done in two centers only.

Conflicts of interest

The authors have none to declare.

References

1. Hong L-F, Luo S-H, Li J-J. Percutaneous coronary intervention with anomalous origin of right coronary artery: case reports and literature review. J Geriatr Cardiol. 2013;10:205–209.
2. Florence B, Coolen N, Nataf F, Tchetch D. Sudden death related to an anomalous origin of the right coronary artery. Ann Thorac Surg. 2008;85:1077–1079.
3. Sarkar K, Sharma SK, Kini AS. Catheter selection for coronary angiography and intervention in anomalous right coronary arteries. Int Cardiol. 2009;22:
4. Kiemeneij F, Laarman G. Percutaneous transradial artery approach for coronary Palmaz-Schatz stent implantation. Am Heart J. 1994;128:167–174.
5. Rahman Su, Wesarg S, Völker W. Patient specific optimal catheter selection for right coronary artery. In: Proceedings of SPIE Medical Imaging. Florida, USA2011.
6. Rauf U. Optimal catheter selection for anomalous Right Coronary Arteries (RCA). (Thesis Number: MEE10:115) Blekinge Institute of technology; January 2011.