Right Versus Left Radial Artery Approach for Coronary Angiography. Differences Observed and the Learning Curve

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INTRODUCTION

The femoral artery is the access of choice for coronary angiography, although this route is limited in patients with peripheral vascular disease and those receiving anticoagulation therapy. Following the procedure, a rest period in the decubitus position is required to avert bleeding from the puncture site. However, despite proper bed rest and careful manual compression, complications involving the femoral artery occur in 2% to 8% of cases. This complication rate has not been reduced with the use of new percutaneous femoral closure systems by suture or collagen, and in some series it has increased with these measures. These factors affect the tolerability, morbidity, length of hospital stay, and cost of the procedure; hence, alternatives to the femoral access have been sought.

The radial artery has become the primary alternative to femoral artery access because of its superficial anatomy.
Body mass index (BMI), age, sex, presence of severe aortic valve disease, and cardiovascular risk factors were recorded for consecutive patients with a negative Allen test (11 RR and 4 LR; \( P = .007 \)) mainly because of tortuosity and calcification of the subclavian artery in 11 patients (10 RR and 1 LR) and for reasons related to completion of angiography. A 5 French introducer was inserted with the Seldinger technique and a combination of 0.2 mg of nitroglycerin, 2 mg of verapamil, and 5000 U of heparin was infused in all cases. Coronary angiography was performed with 5 French catheters and a 0.035-inch exchange guidewire, without a specific curve design for the radial artery, and preshaped Judkins,5 Amplatz and multipurpose catheters. The left coronary artery was imaged in at least three views and the right coronary artery, in at least two views.

Operators were free to use the catheters they deemed appropriate, although they were initially provided with a Judkins left 3.5 curve (JL 3.5) to catheterize the left coronary artery, and a Judkins right 4 (JR 4.0) curve, or multipurpose catheter.

Univariate analysis was used to study the time required for angiography of the left coronary artery and the right coronary artery, starting from the moment when the introducer was inserted. The total fluoroscopy time and the total time of the procedure (from introducer insertion to completion of angiography) were also analyzed. A logistic regression model was created to determine the factors implicated in the development of incidents during the radial procedure. For this purpose, an event was defined as either a complex procedure in which the initially assigned access route could not be completed, or prolonged fluoroscopy, which was arbitrarily established as a time exceeding the last quartile of the distribution of all the fluoroscopy times. We estimated that the approach would not be completed in 5%-7% of cases and there would be an additional 25% of events due to lengthy procedures, which yielded a sample size requirement of more than 350 patients to study the predefined variables in the multivariate analysis.

RESULTS

From November 2003 to May 2004, 351 consecutive patients were randomized (171 RR and 180 LR). The assigned radial artery could not be cannulated in 10 patients, and these were excluded from the analysis.

The subgroups of right and left radial artery access were well distributed for the variables studied: the proportion of type B operators was 24% for the left radial and 25% for the right radial, and the proportion of patients over 70 years old was 45% for the left radial and 41% for the right radial (\( P = \text{NS} \)) (Table 1).

The procedure could not be completed in 15 patients (11 RR and 4 LR; \( P = .007 \)) mainly because of tortuosity and calcification of the subclavian artery in 11 patients (10 RR and 1 LR) and for reasons related to the anatomic characteristics of the left radial (LR) artery access are different from those of the right radial (RR) and could influence application of the coronary catheterization technique. The origin of the right subclavian artery from a common brachiocephalic trunk is the most pronounced difference, since there is a vessel segment (innominate artery) that does not exist in the left radial approach. Atheromatous disease in this segment, which has two consecutive bifurcations, would make it more rigid and increase the difficulty of maneuvering the catheter. The aim of this study was to determine whether use of the right radial approach is associated with more complex coronary catheterization, an increase in the duration of fluoroscopy, and procedure failure as compared with the left radial artery approach, to assess factors that are implicated in the difficulty of coronary angiography with a radial access, and to design a learning curve that will avoid complex procedures at the start of training.

METHODS

This was a prospective study carried out in a single center. Consecutive patients with a negative Allen test and radial pulse in both wrists were randomized for coronary angiography. Variables theoretically implicated in the catheterization procedure, such as body mass index (BMI), age, sex, presence of severe aortic valve disease, and cardiovascular risk factors were recorded for analysis with a logistic regression model. Practitioner experience was defined as A, “expert” and B, “non-expert” (fewer than 100 cases by radial access). The study was approved by the local ethics committee and patients gave informed written consent for the procedure.

A 5 French introducer was inserted with the Seldinger technique and a combination of 0.2 mg of nitroglycerin, 2 mg of verapamil, and 5000 U of heparin was infused in all cases. Coronary angiography was performed with 5 French catheters and a 0.035-inch exchange guidewire, without a specific curve design for the radial artery, and preshaped Judkins,5 Amplatz and multipurpose catheters. The left coronary artery was imaged in at least three views and the right coronary artery, in at least two views.

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**TABLE 1. Characteristics of the Patients**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Right Radial</th>
<th>Left Radial</th>
<th>( P )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients, n</td>
<td>171</td>
<td>180</td>
<td>NS</td>
</tr>
<tr>
<td>Patients, %</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men, %</td>
<td>71</td>
<td>67.4</td>
<td>NS</td>
</tr>
<tr>
<td>Age &gt;70 years, %</td>
<td>41</td>
<td>45</td>
<td>NS</td>
</tr>
<tr>
<td>Hypertension, %</td>
<td>56.8</td>
<td>61</td>
<td>NS</td>
</tr>
<tr>
<td>Diabetes, %</td>
<td>34</td>
<td>33</td>
<td>NS</td>
</tr>
<tr>
<td>Aortic valve disease, %</td>
<td>5.8</td>
<td>6</td>
<td>NS</td>
</tr>
<tr>
<td>Operator (B), %</td>
<td>25</td>
<td>24</td>
<td>NS</td>
</tr>
<tr>
<td>Age, mean±SD</td>
<td>66±10</td>
<td>65±10</td>
<td>NS</td>
</tr>
<tr>
<td>Body mass index</td>
<td>28±4</td>
<td>29±4</td>
<td>NS</td>
</tr>
</tbody>
</table>

\( {SD} \) indicates standard deviation; NS, non-significant.
to the radial artery in 4 patients (calcification, 2 patients [LR], radial loop with arterial remnant, 2 patients [1 RR and 1 LR]).

Univariate analysis showed that use of the RR approach was associated with a lengthier procedure and longer total duration of fluoroscopy (4.35 min with RR vs 3.05 min with LR; \( P=.0001 \)) (Table 2).

With regard to catheter use, there were no significant differences between the groups in the percent of patients that required more than 1 catheter. For the left coronary, more than one catheter was needed in 3.6% of cases in the LR group versus 0% in the RR group (\( P=NS \)). For the right coronary, more than 1 catheter was needed in 12% of the LR group versus 17% of the RR group (\( P=NS \)).

Among the cases treated with a radial access (336), an interventional procedure was performed following the diagnosis in 96 patients (28%), 49 LR and 47 RR (\( P=NS \)), with one RR procedure requiring a change of access due to arterial spasm. The intervention was deferred in 14 patients and a different access route was chosen for 5 patients, 3 RR and 2 LR (\( P=NS \)), on the basis of the operator’s criteria.

Excessive duration of fluoroscopy was considered to be a length of time greater than the last quartile of the distribution of all the fluoroscopy times (5.10 min). Thus, 25% of the patients arbitrarily presented excessive times, and were included in the final combined analysis.

In the logistic regression model, the following variables were significant: operator experience, presence of hypertension, radial access route used, and age over 70 years, with an interaction between these last 2 factors. Use of the RR in patients over 70 was related to a 6-fold greater risk than use of the LR (\( P=NS \)).

One piece of evidence supporting the hypothesis of prolongation of the procedure than age under 70 and use of the RR, which carried a 6-fold higher risk of prolongation of the procedure than age under 70 and use of the LR access route.

We believe that the finding that patients with hypertension present a lower risk of undergoing complex procedures currently has no biological explanation; thus we consider it an incidental finding that should be confirmed in other studies.

Even though this study has some limitations related to the use of arbitrary criteria to define the level of operator expertise and what constitutes a complex procedure, we conclude that the right radial approach should be avoided in patients over 70 years of age when trainee radial operators are at the beginning of the learning curve.

DISCUSSION

At the start of the analysis, the univariate model had already shown that success following insertion of the introducer differed between the two approaches, such that the access route had to be changed more frequently with the RR approach than with the LR approach. The independent nature of this effect was demonstrated in the multivariate analysis, which revealed a higher risk of prolonged procedures in patients catheterized through the RR approach.

These findings contrast with the results of Saito et al., who reported that the LR approach was associated with a larger number of procedure failures due to radial artery anatomic anomalies and left subclavian tortuosity. Wu et al. and Kawashima, however, reported a higher frequency of failures with the RR approach, attributable to right subclavian tortuosity, which impeded the procedure or lengthened fluoroscopy time.

Atheromatosis of the right subclavian artery would have a different influence on the procedure because this vessel arises from the innominate artery, which it shares with the right common carotid, a circumstance that does not occur with the left subclavian.

One piece of evidence supporting the hypothesis of calcification and atheromatosis of this segment is the interaction seen between the factors age over 70 years and use of the RR, which carried a 6-fold higher risk of prolongation of the procedure than age under 70 and use of the LR access route.

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REFERENCES


