Use of 5 French Guiding Catheters in Transradial Coronary Intervention Procedures

Cheng-Hsueh Wu,1 Zu-Yin Chen2 and Lung-Ching Chen3,4

Background: Transradial coronary intervention (TRI) is a widely practiced procedure in Taiwan. Most TRIs are performed using 6 French guiding catheters. Use of smaller-sized vascular sheaths and guiding catheters may further decrease the incidence of vascular access complication, but demand more operator experience and skills in manipulation of the catheter. We report our experience in using 5 French vascular sheaths and guiding catheters for TRI.

Methods: One hundred and sixty consecutive patients who underwent transradial coronary intervention were retrospectively analyzed. Patient demographics, lesion characteristics and procedure-related outcomes were recorded.

Results: Procedural success rates were 96.3% in the 5 French group (n = 81), 92.7% in the 6 French group (n = 41) and 92.1% in the 7 French group (n = 38), respectively. Four patients in the 5 French group needed to upsize to 6 or 7 French vascular sheaths and guiding catheters. Three of these four patients failed the TRI procedure; one patient obtained procedural success after crossover to transfemoral approach. There was a significant difference in the volume of contrast medium used (211.9 vs. 247.8 vs. 272.9 ml in the 5, 6 and 7 French groups, respectively; p < 0.001) and incidence of acute renal failure (0% vs. 9.8% vs. 5.4% in the 5, 6 and 7 French groups, respectively; p = 0.024). There was also a tendency of less post-procedural drop of hemoglobin level (0.5 vs. 0.9 vs. 0.9 g/dl in the 5, 6 and 7 French groups, respectively; p = 0.09) in the 5 French group. The procedural success rate of 5 French TRI showed continuous improvement over the study period. Ninty-five percent of patients in the last quarter of this study period were managed with 5 French sheath. In the late phase of this study, 100% procedural success was obtained in the 5 French group, and more complex lesions could be managed than in the early phase (type B2 or C lesion: 86.5% vs. 56.8% in the late and early phase).

Conclusion: Use of 5 French vascular sheath and guiding catheter for TRI is safe and feasible, with procedural success rate comparable with those using 6 or 7 French guiding catheters, and with reduced amount of contrast medium injection and lower incidence of acute renal failure. After a learning curve, most patients can be managed with 5 Fr sheath and guiding catheter with a high success rate.

Key Words: Catheter • Coronary artery disease • Stent • Transradial

INTRODUCTION

Transradial coronary intervention (TRI) is a widely practiced procedure in Taiwan.1,2 As compared to the traditional transfemoral approach, transradial approach has the advantages of less vascular access site bleeding complication, earlier ambulation, shorter length of stay and increased patient comfort.3,6

In Taiwan and other countries, most TRIs are performed using 6 French (Fr) vascular sheaths and guiding
catheters. Previous studies have shown that the risk of radial artery spasm during procedure or the risk of radial artery occlusion after procedure is related to the ratio of radial artery diameter to vascular sheath diameter.\(^7\) Use of smaller-sized vascular sheaths and guiding catheters may further decrease the incidence of vascular access complication. However, use of 5 Fr guiding catheters has not gained wide acceptance, probably due to physicians’ fear of the learning curve, and demand of more operator experience and skills in manipulation of the catheter. Previous pilot studies had shown the safety and feasibility of 5 Fr TRI.\(^10\)\(^-\)\(^12\) However, only few reports of TRI compared 5 Fr catheters with larger catheters.\(^8\)\(^,\)\(^13\) We report our experience in ad hoc TRI using 5 Fr vascular sheaths and guiding catheters to determine whether 5 Fr TRI might have a favorable impact on procedural parameters and clinical outcomes in comparison with 6 Fr and 7 Fr TRI.

METHODS

Study populations
Between October 2007 and December 2009, a total of 328 coronary artery lesions of 160 consecutive patients underwent percutaneous coronary intervention (PCI) using a transradial approach by a single-operator team. The 160 patients were divided into 5 Fr, 6 Fr and 7 Fr TRI groups. Basic demography, procedural characteristics and clinical outcome of these 160 patients were retrospectively compared in each group. In order to determine whether there was a learning curve in performing 5 Fr TRI, procedures of 5 Fr TRI performed from October 2007 to December 2008 (n = 44) were defined as the early phase while procedures done in 2009 (n = 37) were defined as the late phase.

Sheath insertion procedure, guiding catheter selection and hemostasis
All patients had a normal Allen test, defined as the rapid recovery of the radial artery vascularization after an ischemia induced by manual occlusion of both the radial and ulnar arteries. The initially inserted transradial sheaths were 5 Fr or 6 Fr in size at the discretion of the operator. Diagnostic coronary angiograms were performed with 5 Fr diagnostic catheters, and all patients received ad hoc PCI. The size of guiding catheters for PCI were chosen according to the size of the vascular sheaths. However, if the sheath inserted was 5 Fr in size and the coronary lesions were complex or a kissing balloon technique was planned, the 5 Fr sheath would then be changed to a 7 Fr sheath and a 7 Fr guiding catheter would be used for PCI.

In all instances, the arterial sheath was removed immediately after withdrawal of the catheter. Hemostasis of the radial puncture was achieved by application of a pressure bandage for at least 4 hours. During compression, patients were not restricted to bed rest.

Clinical assessments
Procedural success was defined as a procedure exclusively performed with adequate stent delivery when needed, residual stenosis of less than 30%, and with a final TIMI 3 flow in the dilated artery. Clinical data were collected, including basic demography, lesion characteristics, procedural success rate, total procedure time, amount of contrast medium injected, post-procedure vascular access site hematoma, drop of hemoglobin level and need of blood transfusion. Post-procedure cardiac enzyme (creatine kinase MB fraction, CKMB) was routinely checked. Acute renal failure was defined as rapid decline of renal function with post-procedure creatinine elevation of greater than 1 mg/dl. Post-procedure 30-day major adverse cardiac events (MACE), including repeat myocardial revascularization (PCI or surgery), myocardial infarction (defined as an elevation of CKMB greater than twice the normal upper limit), stroke and death were reported.

Statistical analysis
Results are expressed as proportions or mean ± standard deviation. Differences in categorical variables were analyzed by chi-square analysis, with differences in continuous variables assessed by student’s \(t\)-test or one way ANOVA where appropriate. Statistically significant differences were reached when \(p < 0.05\).

RESULTS

Basic demography
There were a total of 328 coronary artery lesions of
160 consecutive patients who underwent transradial PCI. Patients’ demographic data are provided in Table 1. One hundred and nineteen patients used 5 Fr sheaths as the initial sheath of choice; 81 of them subsequently underwent PCI with 7 Fr guiding catheters. The other 41 patients underwent PCI with 6 Fr sheaths and guiding catheters. There were more patients with diabetes (25.9% vs. 46.3% vs. 21.1% in the 5, 6 and 7 Fr groups, respectively; p = 0.026), history of CABG (2.5% vs. 14.6% vs. 13.2% in the 5, 6 and 7 Fr groups, respectively; p = 0.029), acute ST elevation myocardial infarction receiving primary PCI (0% vs. 9.8% vs. 0% in the 5, 6 and 7 Fr groups, respectively; p = 0.003), and non-ST elevation myocardial infarction (0% vs. 12.2% vs. 0% in the 5, 6 and 7 Fr groups, respectively; p < 0.001) in the 6 Fr group.

Lesion and procedure characteristics

Patients’ lesion characteristics are provided in Table 2. There were fewer bifurcation (13.6% vs. 36.6% vs. 63.2% in the 5, 6 and 7 Fr groups, respectively; p < 0.001), left main (LM) coronary lesions (2.5% vs. 4.9% vs. 23.7% in the 5, 6 and 7 Fr groups, respectively; p < 0.001) and more long diffuse (> 30 mm) lesions (46.9% vs. 26.8% vs. 23.7% in the 5, 6 and 7 Fr groups, respectively; p = 0.017) in the 5 Fr group, and more right coronary artery (RCA) lesions in the 5 and 6 Fr group in comparison with the 7 Fr group (43.2% vs. 34.1% vs. 13.2% in the 5, 6 and 7 Fr groups, respectively; p = 0.005). There was no significant difference of procedure time (112.8 vs. 121.8 vs. 130.4 minutes in the 5, 6 and 7 Fr groups, respectively; p = 0.067) between groups, but significantly lower amount of contrast medium used (211.9 vs. 247.8 vs. 279.2 ml in the 5, 6 and 7 Fr groups, respectively; p < 0.001) in the 5 Fr group.

Post-procedure short-term outcomes

The procedural success rate (96.3% vs. 92.7% vs. 92.1% in the 5, 6 and 7 Fr groups, respectively, p = 0.562) were similar in the three groups (Table 3). PCI remained failed in 3 of 4 patients who crossed-over to using 6 or 7 Fr guiding catheters after a failure of 5 Fr TRI. The only one successful patient with a calcified and tortuous proximal segment of the left anterior descending coronary artery (LAD) was treated by change to transfermoal approach with a 6 Fr backup (Voda) guiding catheter. There were 2 patients with documented puncture site hematoma and another 2 patients with

Table 1. Basic demography of the study population

<table>
<thead>
<tr>
<th>Variables</th>
<th>5 Fr group (n = 81)</th>
<th>6 Fr group (n = 41)</th>
<th>7 Fr group (n = 38)</th>
<th>p values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, years</td>
<td>66.1 ± 12.5</td>
<td>70.0 ± 10.9</td>
<td>67.4 ± 13.3</td>
<td>0.248</td>
</tr>
<tr>
<td>Gender, male</td>
<td>69 (85.2%)</td>
<td>34 (82.9%)</td>
<td>33 (86.8%)</td>
<td>0.886</td>
</tr>
<tr>
<td>Body mass index, kg/m²</td>
<td>25.8 ± 3.4</td>
<td>24.5 ± 3.6</td>
<td>26.5 ± 3.7</td>
<td>0.037abc</td>
</tr>
<tr>
<td>Hypertension</td>
<td>62 (76.5%)</td>
<td>32 (78.0%)</td>
<td>28 (73.7%)</td>
<td>0.898</td>
</tr>
<tr>
<td>Dyslipidemia</td>
<td>63 (77.8%)</td>
<td>25 (61.0%)</td>
<td>28 (73.7%)</td>
<td>0.143</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>21 (25.9%)</td>
<td>19 (46.3%)</td>
<td>18 (21.1%)</td>
<td>0.026abc</td>
</tr>
<tr>
<td>Smoking</td>
<td>38 (46.9%)</td>
<td>24 (58.5%)</td>
<td>18 (47.4%)</td>
<td>0.447</td>
</tr>
<tr>
<td>Previous PCI</td>
<td>32 (39.5%)</td>
<td>13 (31.7%)</td>
<td>13 (34.2%)</td>
<td>0.668</td>
</tr>
<tr>
<td>Previous CABG</td>
<td>2 (2.5%)</td>
<td>6 (14.6%)</td>
<td>5 (13.2%)</td>
<td>0.029ab</td>
</tr>
<tr>
<td>Old MI</td>
<td>6 (7.4%)</td>
<td>1 (2.4%)</td>
<td>1 (2.6%)</td>
<td>0.367</td>
</tr>
<tr>
<td>CHF</td>
<td>5 (6.2%)</td>
<td>6 (14.6%)</td>
<td>6 (15.8%)</td>
<td>0.178</td>
</tr>
<tr>
<td>Old stroke</td>
<td>7 (8.6%)</td>
<td>2 (4.9%)</td>
<td>2 (5.3%)</td>
<td>0.669</td>
</tr>
<tr>
<td>Estimated CCr, mL/min</td>
<td>70.5 ± 31.8</td>
<td>58.6 ± 35.9</td>
<td>67.2 ± 34.7</td>
<td>0.225</td>
</tr>
<tr>
<td>NSTEMI</td>
<td>0 (0%)</td>
<td>5 (12.2%)</td>
<td>0 (0%)</td>
<td>&lt;0.001abc</td>
</tr>
<tr>
<td>STEMI with primary PCI</td>
<td>0 (0%)</td>
<td>4 (9.8%)</td>
<td>0 (0%)</td>
<td>0.003ab</td>
</tr>
</tbody>
</table>

CABG, coronary artery bypass grafting; CCr, creatinine clearance; CHF, congestive heart failure; NSTEMI, non-ST elevation myocardial infarction; MI, myocardial infarction; PCI, percutaneous coronary intervention; STEMI, ST elevation myocardial infarction. 
ab significantly different between the 5 and 6 Fr groups; abc significantly different between the 5 and 7 Fr groups; b significantly different between the 6 and 7 Fr groups.
However, there was a tendency of lower post-procedure drop of hemoglobin in the 5 Fr group (0.5 vs. 0.9 vs. 0.9 g/dl in the 5, 6 and 7 Fr groups, respectively; \( p = 0.095 \)).

There were no differences in 30-day MACE. Two patients who developed mortality in the 6 Fr group were related to ST elevation myocardial infarction and non-ST elevation myocardial infarction. One patient in

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**Table 2. Lesion characteristics of the study population**

<table>
<thead>
<tr>
<th>Variables</th>
<th>5 Fr group (n = 81)</th>
<th>6 Fr group (n = 41)</th>
<th>7 Fr group (n = 38)</th>
<th>p values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient No. (n = 160)</td>
<td>81</td>
<td>41</td>
<td>38</td>
<td></td>
</tr>
<tr>
<td>Vessel No. (n = 223)</td>
<td>112</td>
<td>55</td>
<td>56</td>
<td></td>
</tr>
<tr>
<td>Lesion No. (n = 328)</td>
<td>158</td>
<td>85</td>
<td>85</td>
<td></td>
</tr>
<tr>
<td>LM</td>
<td>2 (2.5%)</td>
<td>2 (4.9%)</td>
<td>9 (23.7%)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Bifurcation</td>
<td>11 (13.6%)</td>
<td>15 (36.6%)</td>
<td>24 (63.2%)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Ostial lesion</td>
<td>6 (7.4%)</td>
<td>3 (7.3%)</td>
<td>6 (15.8%)</td>
<td>0.299</td>
</tr>
<tr>
<td>CTO</td>
<td>9 (11.1%)</td>
<td>8 (19.5%)</td>
<td>5 (13.2%)</td>
<td>0.442</td>
</tr>
<tr>
<td>ISR</td>
<td>9 (11.1%)</td>
<td>5 (12.2%)</td>
<td>7 (18.4%)</td>
<td>0.534</td>
</tr>
<tr>
<td>Calcification</td>
<td>10 (12.3%)</td>
<td>4 (9.8%)</td>
<td>5 (13.2%)</td>
<td>0.881</td>
</tr>
<tr>
<td>Diffuse/long lesion</td>
<td>38 (46.9%)</td>
<td>11 (26.8%)</td>
<td>9 (23.7%)</td>
<td>0.017</td>
</tr>
<tr>
<td>LAD</td>
<td>50 (61.7%)</td>
<td>23 (56.1%)</td>
<td>27 (71.1%)</td>
<td>0.382</td>
</tr>
<tr>
<td>LCX</td>
<td>25 (30.9%)</td>
<td>15 (36.6%)</td>
<td>16 (42.1%)</td>
<td>0.473</td>
</tr>
<tr>
<td>RCA</td>
<td>35 (43.2%)</td>
<td>14 (34.1%)</td>
<td>5 (13.2%)</td>
<td>0.005</td>
</tr>
<tr>
<td>Type A</td>
<td>4 (4.9%)</td>
<td>3 (7.3%)</td>
<td>1 (2.6%)</td>
<td>0.634</td>
</tr>
<tr>
<td>Type B1</td>
<td>20 (24.7%)</td>
<td>7 (17.1%)</td>
<td>7 (18.4%)</td>
<td>0.554</td>
</tr>
<tr>
<td>Type B2</td>
<td>43 (53.1%)</td>
<td>21 (51.2%)</td>
<td>24 (63.2%)</td>
<td>0.502</td>
</tr>
<tr>
<td>Type C</td>
<td>14 (17.3%)</td>
<td>10 (24.4%)</td>
<td>6 (15.8%)</td>
<td>0.552</td>
</tr>
<tr>
<td>Type B2 or C</td>
<td>57 (70.4%)</td>
<td>31 (75.6%)</td>
<td>31 (81.4%)</td>
<td>0.417</td>
</tr>
<tr>
<td>Total procedure time, minutes</td>
<td>112.8 ± 36.4</td>
<td>121.8 ± 43.7</td>
<td>130.4 ± 34.4</td>
<td>0.067</td>
</tr>
<tr>
<td>Contrast volume, ml</td>
<td>211.9 ± 65.8</td>
<td>247.8 ± 73.9</td>
<td>272.9 ± 80.8</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>

CTO, chronic total occlusion; ISR, instant restenosis; LAD, left anterior descending coronary artery; LCX, circumflex coronary artery; LM, left main coronary artery; RCA, right coronary artery.

\( \text{ab} \) significantly different between the 5 and 6 Fr groups; \( \text{ac} \) significantly different between the 5 and 7 Fr groups; \( \text{bc} \) significantly different between the 6 and 7 Fr groups.

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**Table 3. Clinical outcomes of the study population**

<table>
<thead>
<tr>
<th>Variables</th>
<th>5 Fr group (n = 81)</th>
<th>6 Fr group (n = 41)</th>
<th>7 Fr group (n = 38)</th>
<th>p values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Procedure success</td>
<td>78 (96.3%)</td>
<td>38 (92.7%)</td>
<td>35 (92.1%)</td>
<td>0.562</td>
</tr>
<tr>
<td>Shift to 6 or 7 Fr guiding catheters</td>
<td>4 (4.9%)</td>
<td>5 (12.2%)</td>
<td>0 (0.0%)</td>
<td></td>
</tr>
<tr>
<td>Success after shift to 6 or 7 Fr</td>
<td>1 (25.0%)</td>
<td>0 (0.0%)</td>
<td>0 (0.0%)</td>
<td></td>
</tr>
<tr>
<td>Vascular access hematoma</td>
<td>2 (2.5%)</td>
<td>0 (0.0%)</td>
<td>0 (0.0%)</td>
<td>0.372</td>
</tr>
<tr>
<td>Blood transfusion</td>
<td>2 (2.5%)</td>
<td>1 (2.4%)</td>
<td>0 (0.0%)</td>
<td>0.621</td>
</tr>
<tr>
<td>Drop of hemoglobin, g/dL</td>
<td>0.5 ± 0.8</td>
<td>0.9 ± 1.8</td>
<td>0.9 ± 1.0</td>
<td>0.095</td>
</tr>
<tr>
<td>30-day MACE</td>
<td>0 (0.0%)</td>
<td>2 (4.9%)</td>
<td>1 (2.6%)</td>
<td>0.159</td>
</tr>
<tr>
<td>Target vessel revascularization (PCI or CABG)</td>
<td>0 (0.0%)</td>
<td>0 (0.0%)</td>
<td>0 (0.0%)</td>
<td></td>
</tr>
<tr>
<td>Non-fatal MI</td>
<td>0 (0.0%)</td>
<td>0 (0.0%)</td>
<td>0 (0.0%)</td>
<td></td>
</tr>
<tr>
<td>Stroke</td>
<td>0 (0.0%)</td>
<td>0 (0.0%)</td>
<td>1 (2.6%)</td>
<td>0.353</td>
</tr>
<tr>
<td>Death</td>
<td>0 (0.0%)</td>
<td>2 (4.9%)</td>
<td>0 (0.0%)</td>
<td>0.233</td>
</tr>
<tr>
<td>Acute renal failure</td>
<td>0 (0.0%)</td>
<td>4 (9.8%)</td>
<td>2 (5.3%)</td>
<td>0.024</td>
</tr>
</tbody>
</table>

CABG, coronary artery bypass grafting; MACE, major adverse cardiac events; PCI, percutaneous coronary intervention; 30-day MACE included target vessel revascularization, non-fatal MI, stroke and death.

\( \text{ab} \) significantly different between the 5 and 6 Fr groups; \( \text{ac} \) significantly different between the 5 and 7 Fr groups; \( \text{bc} \) significantly different between the 6 and 7 Fr groups.
the 7 Fr group developed stroke 10 days after TRI. The incidence of acute renal failure was significantly lower in the 5 Fr group (0% vs. 9.8% vs. 5.3% in the 5, 6 and 7 Fr groups, respectively; p = 0.024).

Learning curve
Among the 160 consecutive TRI patients within the study period, 119 patients (74%) used 5 Fr sheaths as the initial sheath of choice. The percentage of TRI done by 5 Fr and 7 Fr systems over the different study periods are shown in Figure 1. Almost 94.9% of transradial procedures were performed initially with 5 Fr sheaths (5 Fr guiding catheters and 5 Fr sheaths upsize to 7 Fr sheaths and guiding catheters) in the third and fourth quarter of 2009, and 89.5% of patients were managed with 5 Fr guiding catheters in the fourth quarter of 2009. When we divided the 5 Fr group to early phase (in 2008 or before, 44 patients) and late phase (in 2009, 37 patients), there were significantly more complex lesions (more type B2 or C lesions. 56.8% vs. 86.5% in the early and late phase, respectively; p = 0.004), but insignificant decrease in post-procedure drop of hemoglobin, procedure time and volume of contrast medium injected (Table 4) in the late phase. Procedural success was achieved in 100% of 5 Fr PCI, and there was no crossover to 6 or 7 Fr in the late phase.

DISCUSSION
In this study, there was a lower amount of contrast medium used and a lower incidence of acute renal failure in patients using 5 Fr sheaths and guiding catheters, with procedural success rate comparable with those of the 6 or 7 Fr groups. After a learning curve of about 40 cases, the procedural success rate of the 5 Fr TRI showed continuous improvement over the study period. Ninety-five percent of procedures were attempted with a 5 Fr sheath in the last quarter (the third and fourth quarter of 2009) of the study period. A procedural success rate of 100% could be achieved in the late phase, even with more complex lesions.

The first rationale for using a 5 Fr guiding catheter is to reduce the amount of contrast medium use. One
randomized trial of transfemoral PCI, comparing between 5 Fr and 7 Fr groups, showed a significant decrease of contrast medium used in the 5 Fr group. Our study demonstrated a similar result in transradial PCI. In patients with chronic kidney disease who should receive minimal amount of contrast agent, a strategy of using the 5 Fr guiding catheter is a reasonable choice which may decrease the risk of acute renal failure in these high-risk patients.

The second rationale for using a 5 Fr sheath and guiding catheter is a favorable impact on vascular access complications. Two previous studies compared the 5 and 6 Fr transradial PCI; one by Gwon et al. showed similar local complication rates, and the other one by Dahm et al. showed a tendency of lower vascular access complications (p = 0.07) in the 5 Fr group. Our study didn’t demonstrate significant decrease of vascular access site hematoma, however, there was a tendency of lower post-procedure drop of hemoglobin (p = 0.09) in the 5 Fr group.

Ad hoc PCI patients have a lower 3-year mortality rate, and ad hoc PCIs have become the most common way of practice in Taiwan. In our study, the choice of the size of sheaths was at the discretion of the operator. As shown in Table 1, the operators seemed to prefer to choose 6 Fr sheaths for patients with diabetes, acute myocardial infarction and history of CABG. Naturally, an operator will choose at least a 6 Fr guiding catheter in a predictable complex coronary lesion or in a critical condition, such as a myocardial infarction. However, Hamon et al. had demonstrated the feasibility of minimally invasive strategy with 5 Fr guiding catheter in patients with acute coronary syndrome. In our study, there were more complex lesions managed with 5 Fr systems in the late phase of our study period than the early phase (Type B2 or C lesions were 56.8% vs 86.5% in early and late phase, respectively). A learning curve of about 40 to 50 cases as shown in our study would enable an experienced operator to expand his use of 5 Fr TRI to more complex cases.

There are limitations to performing 5 Fr PCI. When a LM bifurcation is the target lesion or a kissing balloon technique is planned, the minimum catheter size is 6 Fr. In such situations, we changed sheaths from 5 Fr to 7 Fr and used 7 Fr guiding catheters to make the kissing balloon technique easier. The decreased attempts of 5 Fr TRI in early 2009 (shown in Figure 1) were related to increased number of cases requiring use of 7 Fr system. As shown in Table 2, for RCA lesions, we seldom used 7 Fr guiding catheters. This finding may be explained by the fact that the chance for performing a bifurcation lesion PCI is less in the RCA.

We realized that the technique of performing 5 Fr PCI differed from that with use of larger guiding catheters. One of the drawbacks of the 5 Fr system is the poor backup support of the catheter, which may not be strong.

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**Table 4. Comparison between early and late phase**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Early phase</th>
<th>Late phase</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients, No.</td>
<td>44</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>LM</td>
<td>0</td>
<td>2 (5.4%)</td>
<td>0.118</td>
</tr>
<tr>
<td>CTO</td>
<td>4 (9.1%)</td>
<td>5 (13.5%)</td>
<td>0.528</td>
</tr>
<tr>
<td>Diffuse/Long lesion</td>
<td>13 (29.5%)</td>
<td>25 (67.6%)</td>
<td>0.001</td>
</tr>
<tr>
<td>Type B2 or C</td>
<td>25 (56.8%)</td>
<td>32 (86.5%)</td>
<td>0.004</td>
</tr>
<tr>
<td>Total procedure time, minutes</td>
<td>113.0 ± 34.0</td>
<td>112.6 ± 39.6</td>
<td>0.967</td>
</tr>
<tr>
<td>Volume of contrast medium, ml</td>
<td>216.3 ± 57.7</td>
<td>206.8 ± 74.7</td>
<td>0.528</td>
</tr>
<tr>
<td>Hematoma</td>
<td>1 (2.3%)</td>
<td>1 (2.7%)</td>
<td>0.901</td>
</tr>
<tr>
<td>Drop of hemoglobin, g/dl</td>
<td>0.56 ± 0.88</td>
<td>0.40 ± 0.73</td>
<td>0.415</td>
</tr>
<tr>
<td>Transfusion</td>
<td>1 (2.3%)</td>
<td>1 (2.7%)</td>
<td>0.901</td>
</tr>
<tr>
<td>Acute renal failure</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>30-day MACE</td>
<td>0</td>
<td>0</td>
<td>0.356</td>
</tr>
<tr>
<td>Shift to 6 or 7 Fr</td>
<td>4 (9.1%)</td>
<td>0</td>
<td>0.060</td>
</tr>
<tr>
<td>Procedure success</td>
<td>41 (93.2%)</td>
<td>37 (100%)</td>
<td>0.106</td>
</tr>
</tbody>
</table>

Early phase: in 2008 or before; Late phase: in 2009.
enough for PCI in some cases. On the other hand, an unique advantage of the 5 Fr system is that it can be intubated deeply and selectively into coronary arteries, which will increase the rate of successful stent delivery in very complex coronary anatomy. Dahm et al. demonstrated a tendency for higher procedural success using 5 Fr guiding catheter than using 6 Fr. After a learning curve, most patients with more complex lesions (more B2 and C lesions) received PCI with a 5 Fr sheath strategy. In the late phase of our study, the procedural success rate was 100% in the 5 Fr group. Another drawback of the 5 Fr system is a more time-consuming PCI compared with larger guiding catheters. However, Damien et al., comparing 6 and 7 or 8 Fr transfemoral PCI, showed a reduction of procedure time in the 6 Fr group. In our study, there was no significant difference of procedure time in the 5 Fr group in comparison with the 6 and 7 Fr groups.

STUDY LIMITATIONS

Our study was not a randomized controlled study, thus selection bias could have existed in different groups, such as more patients with acute myocardial infarction receiving 6 Fr PCI and more patients with bifurcations receiving 7 Fr PCI. We believed that the amount of contrast medium use and procedure time would be influenced by patient characteristics. In our study, though the patient demography was different, the lesion characteristics was similar between groups according to the classification of type A, B or C. However, a further randomized controlled study should be initiated to prove the superiority of 5 Fr TRI in the amount of contrast medium used. Also, we didn’t record the fluoroscopy time, which could be a drawback of performing 5 Fr PCI. However, the fluoroscopy time should be positively correlated with the procedure time.

CONCLUSION

In conclusion, performing transradial PCI using 5 Fr vascular sheaths and guiding catheters is safe and feasible, with procedural success rate comparable with those using 6 or 7 Fr guiding catheters. Decreased amount of injected contrast medium and lower incidence of acute renal failure were also observed with 5 Fr TRI. After a learning curve, most patients with complex lesions can be attempted with 5 Fr sheaths and guiding catheters with a high success rate.

REFERENCES

13. Gwon HC, Doh JH, Choi JH, et al. A 5Fr catheter approach re-


