Transradial Artery Approach for Coronary Intervention: Maharat Nakhonratchasima Hospital Experience of The First 20 Cases

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Abstract

Background and objectives: Percutaneous coronary intervention (PCI) has emerged as the definitive therapy for obstructive coronary artery disease over the last few decades. Although the transfemoral approach is the standard approach for PCI, transradial approach is now becoming a promising alternative. Transradial PCI is safe and should yield similar results, and has several advantages over the conventional transfemoral approach in terms of complications and ambulation time. The risk of ischemic hand complications is negligible due to collateral circulation in the hand from the ulnar artery.

Methods: From May 2002 to June 2003, we performed transradial coronary intervention in 20 patients with significant coronary obstructive lesions. Allen’s test was performed in every case to evaluate the collateral hand circulation and patients with an abnormal Allen’s test were excluded.

The interventions included balloon angioplasty, balloon angioplasty with stent placement, and direct stenting. Every case of stent placement received clopidogrel 300 mg before the start of the procedure in the catheterization laboratory and 75 mg daily thereafter for 1 month. After the procedure, a compressive device was applied to compress the puncture site at the radial artery for 4 hours and then removed.

Results: 20 patients (18 males and 2 females, mean age: 62 ± 13.7 years, age range: 33 – 83 years) underwent transradial PCI for 31 target lesions. The PCIs’ included balloon angioplasty (3 lesions), balloon angioplasty with stent placement (16 lesions) and direct stenting (12 lesions.) The commonest indication for PCI was high-risk unstable angina. The initial procedural success rate was 100% with no in-hospital mortality. Cases with triple vessel disease, double vessel disease and single vessel disease accounted for 4 (19%), 5 (24%), and 11 (52%) of the total cases, respectively. The target lesions were relatively complex with 71% being type B and C combined. Follow up revealed one case of target vessel restenosis and no cases of radial artery thrombosis.

Conclusion: Transradial coronary interventions in this study yielded a 100% initial successful rate without periprocedural hemorrhagic or ischemic complications and no in-hospital mortality.

Introduction

Since it was introduced, transfemoral approach was the sole standard approach for cardiac catheterization until 1989, when Campeau and colleagues reported the radial artery approach for the procedure. In addition, with the advent of 6-F guiding catheter in 1990, not only diagnostic cardiac catheterization but also percutaneous coronary intervention (PCI) have subsequently become feasible with the transradial approach. Transradial approach has several inherent advantages: 1) the radial artery can be easily compressed so that bleeding can be controlled and the chance of hemorrhage thus virtually be eliminated; 2) due to collateral circulation from the ulnar artery, the hand is protected from ischemia even in the face of occlusion; 3) the artery is not accompanied by a nerve, therefore neurological sequellae are not anticipated. After the procedure, patients can readily ambulate which results in earlier discharge from hospital and this is a critical factor contributing to patients’ preferring this approach to its conventional counterpart.

The purpose of this study is to report our experience with the transradial artery approach for coronary intervention including the technique, complications and results of the procedure.
Methods
Study Population
From May 2002 to June 2003, we performed ad-hoc transradial PCI in 28 patients at the catheterization laboratory, cardiovascular disease center, Maharat Nakhon Ratchasima Hospital. Eight patients who received transradial PCI were eventually switched to transfemoral PCI due to technical difficulties and were excluded, because our aim was to mainly report procedural results. Finally 20 cases with 31 significant coronary lesions (defined as luminal stenosis of > 60%) were included.

All patients were fasted for at least 6 hours before the procedure and informed of the procedural technique as well as its risks. Every patient’s history, physical examination and laboratory findings were reviewed and a written informed consent was obtained in all cases prior to the procedure.

Evaluation of Hand Circulation
Allen’s test was performed prior to transradial coronary angiography and intervention in all patients for evaluation of collateralized circulation of the hand. The test measures the length of time needed to achieve maximal palmar blush after release of ulnar artery compression while continuing occlusive pressure on the radial artery. Patients with hand blushing within 9 seconds or less were considered candidates for transradial approach.

Radial Arterial Access
In the catheterization room, the patient’s right arm was positioned in abduction with support from an arm board attached to the side of the examination table. The wrist was placed in slight overextension above a roll of towel so as not to create constraint, then prepped in sterile fashion and anesthetized with 0.5 - 3 ml of 2% xylocaine over the radial artery area.

A small incision was made with a surgical blade and the radial artery was punctured with a 2.5 cm long, 20-gauge open needle to obtain pulsatile blood flow. Then a 0.025 hydrophilic wire was inserted through the needle and advanced up the artery providing that there was no resistance inside the artery. The needle was then removed; a 6-F transradial sheath inserted and the wire removed. The arm was then positioned alongside the patient.

Through the sheath, 2,500 units of heparin was given before starting the procedure, and additional 2,500 – 5,000 units of the drug was given in cases of PCI to prevent vascular thrombosis. A 0.035” J-tip exchange-wire was advanced through the sheath up to the ascending aorta over which catheters for subsequent catheterization and intervention would then be advanced.

PCI Techniques
PCIs including balloon angioplasty, balloon angioplasty with stent placement, and direct stenting were performed on 31 lesions using a 6-F, FL 4 and a 6-F, FR 4 guiding catheter both with a 3.5 – 4.0 cm curve for left and right coronary artery, respectively. The type and size of guide wire, balloon catheter, and stent were selected according to the type and feature of the target lesions. Patients needing stents were given clopidogrel 300 mg orally in the catheterization laboratory immediately before the procedure.

Hemostasis
Transradial catheterization has the virtue of ease of hemostasis after the procedure which makes immediate removal of artery sheath possible. In our laboratory, we removed the artery sheath immediately once the procedure was completed, and applied pressure over the puncture site with a compressive device under which a rolled gauze-pad was placed to transmit pressure on to the radial artery. After 4 hours of compression, the device was removed and if there was good hemostasis then a non-compressive dressing was applied over the puncture site.

Results
In the 20 patients (18 males, 2 females; age range: 33 – 83 years, mean age: 62 ± 13.7 years), “ad-hoc” transradial PCI was performed in 31 lesions with significant coronary artery stenosis (with a mean of 1.55 lesions per patient.) The interventions included balloon angioplasty (x3), balloon angioplasty with stent placement (x16) and direct stenting (x12.) Repeat PCI was performed in one patient due to restenosis at 6 months’ follow-up. Patient characteristics and indications for coronary angiography / intervention were shown in table 1 and 2, respec-
Of the total 20 patients, 3 (15%) were diabetic and 11 (55%) were hypertensive; with indications of high-risk unstable angina and complicated acute ST-elevation myocardial for the majority of cases (60%, combined). Technically, radial artery puncture and coronary cannulation with a guiding catheter was successful in all cases without access complications.

Table 1. Patient characteristics and coronary risk factors of the 20 cases

<table>
<thead>
<tr>
<th>Patient characteristics</th>
<th>Numbers</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>-Sex:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>18</td>
<td>90</td>
</tr>
<tr>
<td>Female</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>-Mean age (Range)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-male</td>
<td>61.6 ± 14.3 Y (33 – 83 Y)</td>
<td>-</td>
</tr>
<tr>
<td>-female</td>
<td>65.5 ± 11.8 Y</td>
<td>-</td>
</tr>
<tr>
<td>-Diabetes</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>-Hypertension</td>
<td>11</td>
<td>55</td>
</tr>
<tr>
<td>-Dyslipidemia</td>
<td>5</td>
<td>25</td>
</tr>
<tr>
<td>-Smoking</td>
<td>9</td>
<td>45</td>
</tr>
</tbody>
</table>

Table 2. Indications for coronary angiography and intervention of the 20 cases

<table>
<thead>
<tr>
<th>Indication</th>
<th>Number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unstable angina, high-risk</td>
<td>6</td>
<td>30</td>
</tr>
<tr>
<td>Chronic stable angina with failed medication</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>Positive EST at low level</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>Complicated acute ST-elevation myocardial infarction (STEMI)</td>
<td>6</td>
<td>30</td>
</tr>
<tr>
<td>Post myocardial infarction angina</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Non ST-elevation myocardial infarction (NSTEMI)</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Left ventricular dysfunction</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>(Access coronary restenosis at 6 month follow-up)</td>
<td>(1)</td>
<td></td>
</tr>
</tbody>
</table>

Table 3 (below) shows the results of coronary angiography. Single vessel disease was the commonest finding (11 cases, or 52%). One patient with recurrent chest pain and exertional dyspnea at 6 months' follow-up was found to have instent restenosis. Locations of target vessel lesions and their characteristics are shown below in tables 4 and table 5, respectively.

LAD coronary artery was the commonest target vessel, with the lesion being found most frequently at the proximal part (11 lesions, or 35%). Lesions in RCA ranked second accounting for 11 (35%). Type B1 and type C constituted the major proportion of the target lesions, i.e. 71% with the combination of both, reflecting the rather complex lesion profile of the study. The mean reference vessel diameter in this study was 3.05 mm with a range of 2.0 mm. to 4.0 mm. Balloon angioplasty with stent placement was successfully performed in one case of chronic total occlusion (CTO).

The procedure time varied from 20 to 162 minutes with a mean of 76.9 ± 42 minutes, while heparin dosage varied from 5,000 to 7,000 units per procedure with a mean of 5,600 units. At the end of the transradial procedure, the vascular sheath was removed from the radial artery immediately and the puncture site was compressed with a compressive device for 4 hours. All the patients were transferred to the coronary care unit (CCU) where the compressive device was removed by the operator. We found no hemorrhagic complications either at the time of compressive device removal or on the next day following the procedure. Some patients complained of pain at the radial compression site which was relieved with oral analgesics. Most patients were discharged from hospital a few days after the procedure.
The immediate angiographic results in this study were extremely promising as we achieved a 100% success rate. Success was defined as having residual stenosis of less than 30%. One patient had an acute stent thrombosis with complete heart block and required balloon re-angioplasty with accompanying intra aortic balloon pump (IABP) and temporary pacing. The patient was able to be discharged from hospital one week later without serious complications. No in-hospital mortality was reported in this report.

On the first routine follow-up at the out-patient unit, 2 – 4 weeks after the procedure, reversed Allen’s test was performed in all patients to confirm the patency of radial artery and no abnormalities were found.

**Discussion**

Although experience with the transradial approach is limited compared with the transfemoral approach, this new approach for coronary intervention has been performed in properly selected groups of patients with very high success rates, 88 – 100%\(^1\)\(^-\)\(^4\). In this study, we aimed to report the procedural results (8 cases were excluded from the study due to technical difficulties and eventually received femoral PCI). We performed transradial PCI in 20 patients with 31 coronary lesions and had an initial angiographic success rate of 100%. Although the radial artery is prone to spasm triggered by fear, pain and anxiety, percutaneous transradial access has been successful in approximately 93 – 99% of cases. Predictors of failure include female gender, higher age, low body mass index and lack of operator experience\(^5\). In a study of 1,300 coronary interventions with the transradial approach, vascular access complications occurred in 1.1% (mainly hematomas of forearm or arm); 0.15% of the patients required surgery but none required blood transfusion\(^6\). In our series, however, we recorded no such complications.

Catheterization with the transradial approach has a much lesser risk of vascular complications because of the presence of the ulnar artery and because the radial artery can be easily compressed. Moreover, the discomfort associated with long bed rest is minimized because the patients can ambulate immediately after the procedure. By adopting radial artery access, several indices of quality of life have been shown to be improved\(^7\). Although there was some discomfort with the compressive device at the puncture site in some cases, it was relieved with only oral analgesics. The ACCESS study, a prospective randomized study of PTCA with 6-F catheters adopting transradial, transbrachial, and transfemoral approach demonstrated fewer bleeding complications with transradial PTCA, but similar PTCA success rate and cardiac events among the 3 approaches\(^8\).

Radial artery thrombosis, which is generally asymptomatic in patients with a patent arterial arch, occurs in 3% - 6% of procedures. Predictors of the thrombosis are large sheath size and a lower dose of heparin\(^9\). Immediate sheath withdrawal could reduce the incidence of such a complication. At our catheterization laboratory, we gave heparin 5,000 – 7,000 units to the patients during the procedure and did not find any cases with abnormal reversed
Allen’s test indicating abnormal radial artery flow. In some studies asymptomatic radial artery occlusion has been reported as high as 6 – 10% \(^{10-12}\). However in another study with a large series of 7,049 transradial procedures, vascular complications were extremely rare and found in less than 1/3000 cases\(^{13}\).

Currently, up to 80% of PCIs are accomplished with the assistance of stent placement\(^{14}\). In this report, we have stented 90% of the lesions, both with and without pre-dilatations, using the transradial approach with zero in-hospital mortality. Although in the early stages of operator experience with this approach, we were able to perform transradial coronary intervention in a group of patients with rather complex lesions (71% of lesions of type B1 and C combined, with an average 1.55 lesions per patient) and a mean procedure time of 76.9 ± 41.9 minutes. Although the transradial approach procedure can be performed with a high success rate and few complications, it was of the utmost importance for the operator to attain good interventional skills and be familiar with the procedure as well as to be able to detect any complications early.

**Conclusion**

We report our early experiences in the transradial approach for coronary interventions in 20 patients with 31 rather complex lesions. The initial angiographic success rate was 100% with no peri-procedural hemorrhagic complications or in-hospital mortality. One patient developed acute stent thrombosis in the catheterization room at the end of the procedure which was promptly corrected.

Although in well selected cases, transradial coronary intervention can be performed with safety and good results, it requires however, an operator with good interventional skills. With more and more successful reports, the transradial approach could certainly become a more promising alternative for PCI and also provide more technical options for interventionists.

**References**

การส่วนหัวใจทางหลอดเลือดแดง radial เพื่อการรักษาหลอดเลือดหัวใจคิวป์: ประสบการณ์จากโรงพยาบาลมหาวิทยาลัยราชภัฏจันทบุรี 20 ราย

พิษิษ แก้วศุภาวดี พ.ม.
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บทคัดย่อ

การส่วนหัวใจเพื่อการรักษาหลอดเลือดหัวใจคิวป์ โดยดนันต์ ศิริสุรนันท์ ศิริวัณีชัย พ.ม. และสุนิสาโอภาสใจและหลอดเลือด โรงพยาบาลมหาวิทยาลัยราชภัฏจันทบุรี 20 ราย

วัตถุประสงค์: เพื่อรายงานประสบการณ์การส่วนหัวใจทางหลอดเลือดแดง radial เพื่อการรักษาหลอดเลือดหัวใจคิวป์

ผลการค้นหา: ผู้ป่วย 20 ราย ได้รับการส่วนหัวใจทางหลอดเลือดแดง radial เพื่อการรักษาหลอดเลือดหัวใจคิวป์ โดยมีค่าหัวใจที่สูงที่สุด 41 ตัวแทน เป็นเพศชาย 18 ราย เพศหญิง 2 ราย โดยมีอายุระหว่าง 33 – 83 ปี ทั่วไปอยู่ในช่วง 62 ± 13.7 ปี ข้อมูลเกี่ยวกับการส่วนหัวใจทางหลอดเลือดแดง radial พบ 100% โดยไม่มีผู้ป่วยเสียชีวิตในโรงพยาบาล และจากการสืบค้นผู้ป่วยที่ผ่านการส่วนหัวใจทางหลอดเลือดแดง radial พบ 100% โดยไม่มีผู้ป่วยเสียชีวิตในโรงพยาบาล หรือไม่ได้รับการส่วนหัวใจทางหลอดเลือดแดง radial เพื่อการรักษาหลอดเลือดหัวใจคิวป์

สรุป: การส่วนหัวใจทางหลอดเลือดแดง radial เพื่อการรักษาหลอดเลือดหัวใจคิวป์ สามารถทำได้ด้วยความปลอดภัย และไม่มีผู้ป่วยเสียชีวิตระหว่างอยู่ในโรงพยาบาล

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