

# Repeated Transradial Catheterization:

## Feasibility, Efficacy, and Safety

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*Transradial access is an alternative to the transfemoral approach in coronary interventions. It results in less access-site bleeding, shorter hospital stays, lower costs, and less pain for the patient. However, some authors have suggested that the transradial approach might lead to radial artery occlusion, which precludes repeated same-artery catheterizations. Using data from our center, we evaluated the feasibility, safety, and efficacy of repeated transradial catheterization.*

We reviewed the 3,006 transradial catheterizations performed at our center from 2006 through 2009. Patients who had undergone at least one repeated transradial catheterization were identified, their cases monitored through 2012, and their baseline characteristics and other factors, including procedural sequelae, were analyzed.

Seventy-nine patients underwent repeated right radial artery catheterizations, for a total of 92 repeated procedures. Repeated access to the right radial artery was not achieved in 4 attempts (failure rate, 4.3%), because of poor pulses or the operator's inability to advance the wire. No major sequelae were noted. The average times between the 1st to 2nd, 2nd to 3rd, and 3rd to 4th catheterizations were 406, 595, and 401 days, respectively.

Our procedural success rate of 95.7% in performing repeated transradial catheterizations with no major sequelae provides support for the efficacy and safety of such procedures. (*Tex Heart Inst J* 2014;41(6):575-8)

**T**ransradial access has emerged as an alternative to the transfemoral approach in interventional cardiology.<sup>1-5</sup> Accumulated clinical data from centers that have adopted the transradial approach support the conclusion that this technique results in shorter hospital stays,<sup>5,6</sup> reduced costs,<sup>3,7</sup> less pain, significantly less access-site bleeding,<sup>8-10</sup> and improved overall morbidity and mortality rates.<sup>11-15</sup> However, the routine use of the radial artery as an access site for cardiac catheterization has prompted questions about the feasibility, efficacy, and safety of repeated transradial procedures.<sup>16-19</sup> Authors have suggested that routine use of the radial artery might lead to a relatively frequent occurrence of arterial occlusion, limiting this vessel's viability as an access site for repeated procedures.<sup>20-23</sup>

In 2006, our institution adopted radial access as the preferred route for elective, urgent, and emergency catheterization procedures. We used our center's clinical experience to evaluate the feasibility, efficacy, and safety of repeated catheterizations through the same radial artery.

### Patients and Methods

This observational study was conducted at the American Heart Institute in Nicosia, Cyprus. It was approved by the institutional review board.

**Study Population.** Our institution's electronic database was used to identify the initial cohort of all patients who had undergone transradial cardiac catheterization from January 2006 through December 2009. Next, patients in that cohort who had undergone repeated same-artery transradial cardiac catheterization were identified. These patients' records were monitored through December 2012, to identify additional repeated catheterizations. After review of the records by an independent researcher, the study-eligible patients were selected. Their baseline characteristics (including age, sex, cardiovascular disease risk factors, comorbidities, and prior heart surgery) were entered into a computerized database. In addition, information on major sequelae and success rates were recorded.

**Catheterization Approach.** At our institution, we routinely attempt all cardiac catheterization procedures through the right radial artery. This includes all elective, urgent, and emergency procedures, such as in ST-elevation myocardial infarction. If right radial access is unsuccessful, we attempt left radial access. We proceed to femoral access only if radial access is precluded.

**Catheterization Procedure.** Radial access was attempted in all patients who had a palpable pulse at the radial artery. No radial or ulnar artery Doppler ultrasound was used. Lidocaine (2%) was the agent for local anesthesia at the radial artery puncture site. For diagnostic catheterization, we used 4F catheters in 9.7% of cases, 5F catheters in 64.5%, and 6F catheters in 25.8%. For stenting the coronary arteries, we used 5F guiding catheters in 29.3% of cases and 6F catheters in 70.7%, along with standard guidewires, balloons, and stent catheters. After each procedure, a wristband was used to achieve hemostasis. Patients were typically discharged from the hospital on the day of diagnostic procedures and on the day after stenting.

**Statistical Analysis.** Data analyses were performed with use of “R” version 2.15.2, an open-source programming language for statistical computing and graphics.

## Results

We reviewed 3,006 radial-access procedures. Of these, 2,914 were initial procedures and 92 were repeated.

In total, 79 patients underwent more than one radial-access procedure. In those patients, 171 radial procedures were attempted (67 patients  $\times$  2 catheterizations, 11 patients  $\times$  3, and 1 patient  $\times$  4). Of the 171 procedures, 79 were initial (each patient underwent an initial procedure) and 92 were repeated procedures.

The mean age of the 79 patients who underwent repeated transradial catheterizations was  $64.8 \pm 10$  years (range, 40–89 yr), and 69 were male (87.3%). Table I shows the characteristics of the patients.

In all 79 patients, the initial transradial catheterization was performed through the right radial artery, for the purpose of diagnostic angiography ( $n=26$ ) or for angiography with stent placement ( $n=53$ ). All subsequent repeated procedures were for balloon angioplasty or stent placement.

Among the 67 patients who needed 2 catheterizations, 65 successfully underwent the 2nd repeated right transradial catheterization; in 2 patients, the 2nd procedure was unsuccessful, and catheterization was eventually performed through the left radial artery. Among the 11 patients who needed 3 catheterizations, 10 successfully underwent the 3rd catheterization; in one patient, the 3rd procedure was eventually performed through the left radial artery. Finally, in one patient, a 4th right repeated transradial catheterization was unsuccessfully attempted, and catheterization was ultimately completed through the left radial artery (Table II).

**TABLE I.** Characteristics of the 79 Patients

Variable	Value
Age, yr	
Mean (range)	64.8 $\pm$ 10 (40–89)
35–54	14 (17.7)
55–64	24 (30.4)
65–74	28 (35.4)
$\geq 75$	13 (16.5)
Sex	
Male	69 (87.3)
Female	10 (12.7)
Body mass index, kg/m <sup>2</sup>	
Mean (range)	28.2 $\pm$ 4.14 (17–37)
<25	10 (12.7)
25–29	34 (43)
30–35	22 (27.8)
$\geq 36$	2 (2.5)
Data unavailable	11 (13.9)
Smoking	
No	29 (36.7)
Yes	26 (32.9)
Data unavailable	24 (30.4)
Diabetes mellitus	
No	61 (77.2)
Yes	13 (16.5)
Data unavailable	5 (6.3)
History of CABG	
No	70 (88.6)
Yes	2 (2.5)
Data unavailable	7 (8.9)
Heart rate, beats/min	
Mean (range)	71.25 $\pm$ 12.6 (47–103)
<60	12 (15.2)
60–79	45 (57)
80–99	13 (16.5)
$\geq 100$	3 (3.8)
Data unavailable	6 (7.6)
Systolic blood pressure, mmHg	
Mean (range)	141.1 $\pm$ 21.6 (84–210)
<120	12 (15.2)
120–139	22 (27.8)
140–159	29 (36.7)
$\geq 160$	11 (13.9)
Data unavailable	5 (6.3)
Diastolic blood pressure, mmHg	
Mean (range)	83.5 $\pm$ 12.4 (52–132)
<80	24 (30.4)
80–89	24 (30.4)
90–99	21 (26.6)
$\geq 100$	4 (5.1)
Data unavailable	6 (7.6)

CABG = coronary artery bypass grafting

Values are presented as mean  $\pm$  SD or as number and percentage.

mately completed through the left radial artery (Table II).

In summary, among the 92 repeated right radial procedures attempted, 88 succeeded (95.7%) and 4 failed (4.3%). The failures were because of poor pulses ( $n=3$ ) and the operator’s inability to advance the wire ( $n=1$ ).

**TABLE II.** Results of 92 Repeated Catheterization Procedures through the Right Radial Artery

Patients (n)	Right Radial Catheterization Attempt*			
	1st	2nd	3rd	4th
65	Successful	Successful	—	—
2	Successful	Unsuccessful	—	—
10	Successful	Successful	Successful	—
1	Successful	Successful	Unsuccessful	—
1	Successful	Successful	Successful	Unsuccessful

\*After all 4 unsuccessful attempts, access was attained through the left radial artery.

**TABLE III.** Studies of Repeated Transradial Catheterization

Reference	Patients (n)	Repeated Procedures (n)	Success Rate (%)	Main Study Findings
Caputo RP, et al. <sup>16</sup> (2001)	1,362	73	97.9	Procedure success rates, complication rates, and procedure times were similar between initial and repeated procedures.
Yoo BS, et al. <sup>17</sup> (2003)	1,771	117	98.3	No significant difference in access times and procedural success between the initial and the repeated procedure. The incidence of radial arterial occlusion was higher for repeated procedures (2.6% vs 0).
Magariños E, et al. <sup>18</sup> (2007)	182	17	88.2	Even in centers with small initial experience in transradial access, the success rate in repeated procedures is high.
Valsecchi O and Vassileva A <sup>19</sup> (2010)	4,818	670	98.1	No significant difference seen in radial puncture success rate and vascular access time between initial and repeated procedures.
Current study	3,006	92	95.7	Success rate >95% with no major sequelae supports the efficacy and safety of repeated transradial procedures.

In the 4 patients in whom right radial access was unsuccessful, the procedures were eventually performed through the left radial artery. Transition to femoral access was never necessary.

During the study period, the access failure rate in the 2,914 initial radial-access procedures was 0.6%, compared with the 4.3% rate in the repeated procedures.

We calculated the time intervals between all repeated transradial catheterizations. The average times from the 1st to 2nd, 2nd to 3rd, and 3rd to 4th catheterizations were 406, 595, and 401 days, respectively.

We noted no major sequelae in any patient who underwent repeated transradial catheterization, and no substantial access-site bleeding was recorded. The few instances of mild skin ecchymosis and access-site pain were easily controlled with acetaminophen, typically during the day of the procedure.

## Discussion

Despite the increasingly frequent adoption of transradial access in cardiology centers worldwide, few investi-

gators have examined the feasibility, efficacy, and safety of repeated transradial catheterizations. We found 4 relevant studies<sup>16-19</sup> in the international medical literature (Table III).

Like the above studies, ours revealed a high success rate for repeated radial procedures, and without major sequelae. Our success rate for repeated procedures was 95.7%, compared with 99.4% in initial procedures. Despite the higher failure rate in repeated procedures (4.3% vs 0.6%), the success rate remained high (>95%).

Furthermore, our study results help to assuage the concerns of previous authors in regard to radial artery occlusion after transradial catheterization.<sup>20-23</sup> Whereas radial artery occlusion might occur immediately after catheterization, the artery might recanalize over time. We were unable to achieve repeated radial access in only 4 patients, which indicates that radial artery occlusion was rarely significant and always asymptomatic.

Our study has some limitations. We did not record the duration of each procedure, nor did we document the time needed to gain arterial access in the initial versus the repeated procedures. In addition, we did not

document the exact amount of contrast agent used in each case; however, none of our patients experienced contrast-induced nephropathy. Our study was of retrospective design, with the associated limitations. In addition, we had the opportunity to clinically document radial artery occlusion only in those patients who underwent repeated right radial catheterizations. There might have been asymptomatic and therefore undocumented cases of arterial occlusion in patients who underwent only one catheterization. We did not implement a systematic follow-up procedure to evaluate the patients at certain, predefined intervals for comparison of the results. Instead, patients were physically examined postprocedurally at different times, in accordance with their regular appointments with their physicians at our institution.

We conclude that our study provides evidence of the feasibility, efficacy, and safety of repeated transradial catheterizations.

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