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Radiation Safety

Operator Radiation Exposure and Physical Discomfort During a Right Versus Left Radial Approach for Coronary Interventions

A Randomized Evaluation

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Objectives This study sought to assess radiation exposure and operator discomfort when using left radial approach (LRA) versus right radial approach (RRA) for coronary diagnostic and percutaneous interventions.

Background The transradial approach is increasingly being adopted as the preferred vascular access for coronary interventions. Currently, most are performed using an RRA. This is in part due to the perceived increased operator physical discomforts as well increased radiation exposure with an LRA.

Methods One hundred patients were randomized to an LRA or RRA. Each operator ($n = 5$) had an independent randomization process, and patients were stratified according to obesity status. Operator radiation was measured using separate sets of radiation dosimeter badges placed externally on the head and thyroid and internally on the sternum. Operator physical discomfort was surveyed at 2 time points: during vascular access and at the end of the procedure. Moderate to severe physical discomfort was defined as a score of >4.

Results There were no significant differences in baseline and procedural variables between groups. There was a significant increase in external radiation exposure using the RRA versus LRA (head: median: 6.12 [interquartile range (IQR): 2.6 to 16.6] mRems vs. median: 12.0 [IQR: 6.4 to 22.0] mRems, $p = 0.02$; thyroid: median: 10.10 [IQR: 4.3 to 25] mRems vs. median: 18.70 [IQR: 11.0 to 38] mRems, $p = 0.001$). More discomfort was reported with the LRA during access (LRA: 22% vs. RRA: 4%; $p = 0.017$), but not during the procedure (LRA: 10.0% vs. RRA: 4.0%, $p = 0.43$). This difference was almost entirely noted in obese patients (LRA: 30.0% vs. RRA: 3.7%, $p = 0.005$).

Conclusions LRA is as effective as RRA, showing a safer profile with decreased radiation exposure to the operator, at the expense of more operator discomfort only during vascular access and limited to obese patients. (J Am Coll Cardiol Intv 2014;7:810–6) © 2014 by the American College of Cardiology Foundation

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Transradial artery access is a safe and effective approach in patients undergoing percutaneous coronary interventions. The benefits of transradial artery access include lower incidence of access-site bleeding complications, decreased patient discomfort, promoted patient ambulation, and decreased length of hospital stay when compared with the benefits of a transfemoral approach (1). Steadily increasing in use, the transradial approach is now considered the standard of care in many centers (2).

Most data comparing femoral with radial access derive from studies using a right radial approach (RRA), and there are limited data comparing RRA with left radial approach (LRA). Historical data have shown increased radiation exposure with radial access, mostly RRA, compared with exposure with femoral access. Moreover, trials have shown a significant increase in procedure time, radiation exposure, and room time using the LRA compared with the RRA (3). It has been suggested that the LRA presents greater difficulty for the operator, especially if the patient is obese or the operator is short. However, pitfalls in these studies may have contributed to these observations. A recent large randomized trial suggested that, when compared with an RRA, an LRA is associated with lower fluoroscopy time (FT) (4). LRA is also associated with less operator radiation exposure to the wrist (5). Furthermore, when compared with LRA, RRA is known to be complicated by a higher frequency of failure due to anatomical variations, including a higher rate of right subclavian artery tortuosity, especially in elderly patients (6,7). To overcome the limitations of previously reported data on radial access, we conducted a prospective randomized study with the aim of assessing radiation exposure and operator discomfort when using LRA versus RRA for coronary diagnostic and percutaneous interventions.

Methods

Patient population. This was a single center, prospective, randomized study conducted from July 2011 to October 2012. Patients were screened at the Division of Cardiology of the University of Florida College of Medicine–UF Health Jacksonville. A total of 100 patients undergoing transradial left heart catheterization, with or without the possibility of percutaneous coronary intervention, were randomly assigned to LRA or RRA. Procedures were performed by 5 operators with different levels of experience in transradial approach, ranging from 1 year of experience and 100 radial procedures performed to >15 years of experience and >1,000 radial procedures performed. Patients presenting with ST-segment elevation myocardial infarction, hemodynamic instability, previous coronary artery bypass graft, arteriovenous fistulas for hemodialysis, nonpalpable radial pulse, or an abnormal Allen test and who were <18 or >80 years of age were excluded from the study.

Study design and procedures. The study protocol and design was approved by the local institutional review board committee at the University of Florida College of Medicine—Jacksonville. After providing written informed consent, patients were randomized to RRA or LRA using a computer-generated 1:1 sequence that was unique to each operator, with the intention of avoiding operator-related imbalance. In addition, to warrant balance among both access groups, patients were stratified according to obesity status, defined as body mass index (BMI) ≥30 mg/kg^2. Therefore, each operator had a total of 4 sets of 3 radiation badges (left radial + high BMI, left radial + normal BMI, right radial + high BMI, and right radial + normal BMI) to assess for radiation exposure.

For patients assigned to RRA, the patient's right arm was secured to an arm board on the same side of the operator. For patients assigned to LRA, the left arm was elevated with appropriate support and rotated in order to be supine. The left digits were restrained with orthopedic finger traps connected with a sling. After access was obtained, the sling holding the finger was pulled and secured, mobilizing the left forearm toward the right side of the table, and closer to the operator to perform the procedure (Fig. 1).

Abbreviations and Acronyms

BMI = body mass index
FT = fluoroscopy time
LRA = left radial approach
RRA = right radial approach

Radial artery access was obtained by modified Seldinger technique with an 18-gauge needle. A 5-F or 6-F hydrophilic radial sheath was used (Terumo Corporation, Tokyo, Japan). Administration of verapamil (3 mg) and unfractionated heparin (3,000 IU) were provided intra-arterially through the radial sheath before the initiation of the procedure. A 0.035-inch J-tip wire was inserted and used to introduce the catheters. A 2-catheter procedure was performed in all patients with mandatory Judkins diagnostic catheters as the initial attempt for coronary angiography. Use of additional equipment, that is, additional wires or catheters, was on the basis of the clinical judgment of the operator. All diagnostic procedures used a minimum of 2 views for selective right coronary angiogram and a minimum of 4 views for left coronary angiogram, with additional projections allowed at the discretion of the operator. Additional views were also obtained as deemed necessary for any interventions. Upon removal of the transradial sheath, an inflatable transradial band (Terumo Corporation) was used to compress the artery to obtain hemostasis.

Radiation measurements. All operators performed the procedure from the patients' anatomical right side. Operator's radiation protection included the standard lead apron, a thyroid lead collar, leaded glasses, low-leaded flaps, and an upper mobile leaded glass suspended from the ceiling in all procedures. Operator radiation exposure was assessed with a set of 3 aluminum oxide radiation detection dosimeters (Landauer Inc., Glenwood, Illinois) strategically placed in