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Real-Time Ultrasound Guidance Facilitates Transradial Access

RAUST (Radial Artery Access With Ultrasound Trial)

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ABSTRACT

OBJECTIVES This study sought to assess the utility of ultrasound (US) guidance for transradial arterial access.

BACKGROUND US guidance has been demonstrated to facilitate vascular access, but has not been tested in a multicenter randomized fashion for transradial cardiac catheterization.

METHODS We conducted a prospective multicenter randomized controlled trial of 698 patients undergoing transradial cardiac catheterization. Patients were randomized to needle insertion with either palpation or real-time US guidance (351 palpation, 347 US). Primary endpoints were the number of forward attempts required for access, first-pass success rate, and time to access.

RESULTS The number of attempts was reduced with US guidance [mean: 1.65 ± 1.2 vs. 3.05 ± 3.4, $p < 0.0001$; median: 1 (interquartile range [IQR]: 1 to 2) vs. 2 (1 to 3), $p < 0.0001$] and the first-pass success rate improved (64.8% vs. 43.9%, $p < 0.0001$). The time to access was reduced (88 ± 78 s vs. 108 ± 112 s, $p = 0.006$; median: 64 [IQR: 45 to 94] s vs. 74 [IQR: 49 to 120] s, $p = 0.01$). Ten patients in the control group required crossover to US guidance after 5 min of failed palpation attempts with 8 of 10 (80%) having successful sheath insertion with US. The number of difficult access procedures was decreased with US guidance (2.4% vs. 18.6% for ≥5 attempts, $p < 0.001$; 3.7% vs. 6.8% for ≥5min, $p = 0.07$). No significant differences were observed in the rate of operator-reported spasm, patient pain scores following the procedure, or bleeding complications.

CONCLUSIONS Ultrasound guidance improves the success and efficiency of radial artery cannulation in patients presenting for transradial catheterization. (Radial Artery Access With Ultrasound Trial [RAUST]; NCT01605292) (J Am Coll Cardiol Intv 2015;8:283–91) © 2015 by the American College of Cardiology Foundation.

Transradial catheterization is associated with reduced access site complications and increased patient comfort compared with transfemoral catheterization (1). In patients with ST-segment elevation, there is a decrease in mortality associated with the transradial approach (1,2). However, despite increased interest, there is a significant learning curve to transradial catheterization and the proportion of transradial percutaneous coronary intervention (PCI) procedures performed is still low in the United States at approximately 16% (3).

Failure to access the transradial artery is the cause of 57% of all transradial PCI failures (4). The radial artery is small at 2.4 to 2.6 mm (5), which approaches the 2- to 4-mm 2-point discrimination limit of fingertip palpation (6). The radial artery may also be

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ABBREVIATIONS AND ACRONYMS

CI = confidence interval

IQR = interquartile range

OR = odds ratio

PCI = percutaneous coronary interventions

PVD = peripheral vascular disease

US = ultrasound

diminutive, collapsible, calcified, mobile, or associated with anatomic anomalies or dilated radial veins. Difficulty or delays with radial access may contribute to the reluctance of operators in adopting transradial catheterization, particularly for primary PCI (2,7).

Real-time ultrasound (US) guidance has been demonstrated to facilitate safe and more efficient vascular access in central veins and in the femoral artery (8,9). Several previous small trials have demonstrated potential benefit in radial artery lines outside of the catheterization laboratory (10), but the technique has not been tested in a multicenter prospective study focused on transradial access for cardiac catheterization.

METHODS

STUDY DESIGN. RAUST (Radial Artery access with Ultrasound Trial) was a prospective, multicenter randomized controlled trial of transradial access with palpation or US guidance. The study was investigator-initiated and unsponsored. All patients provided written informed consent for the research study, and the study was approved by the Institutional Review Board of each institution. Adult patients presenting for planned transradial cardiac catheterization procedures were included in the trial, provided that a trained operator and working US machine were available. Patients with emergent procedures, chronic renal disease on hemodialysis, nonpalpable radial pulse, or abnormal hand collateral circulation (abnormal Allen test or Barbeau class D) were excluded from the study. Patients with previous ipsilateral radial puncture within the week prior to the procedure were also excluded.

EQUIPMENT. The study used US machines with a high-frequency linear array transducer capable of imaging and displaying at a depth of 2 mm with a screen of at least 12.1 diagonal inches. The machines included the M-Turbo with L25x or HFL38x 6 to 13 MHz transducer (Sonosite Inc., Bothell, Washington), the Site-Rite Vision with linear 5 to 10 MHz transducer (Bard Access, Salt Lake City, Utah), and the iU22 xMATRIX with L12-5 5 to 12 MHz transducer (Philips Healthcare, Andover, Massachusetts). Sterile probe covers and transducer gel were used for all US procedures. No needle guides were used for this study.

OPERATOR TRAINING. This study included operators experienced in transradial catheterization to minimize potential confounders. Participation in the study required a minimum of 100 previous radial artery catheterization procedures, with at least 15 US-guided procedures. Thirteen attending physicians and 3 advanced interventional fellows participated in the study across 6 sites.

RANDOMIZATION. Patients were randomized in a 1:1 fashion to either palpation or US guidance using sealed envelopes balanced in blocks of 50 to 80 generated at each center. Patients were not randomized until a single trained operator was assigned to their procedure.

STUDY PROCEDURES. All patients received assessment of the hand circulation using either the Allen test or Barbeau test. All procedures were performed according to local standard and operator preference with the exception of palpation or US guidance. Patients received conscious sedation, 5-F or 6-F sheaths, and intra-arterial and/or subcutaneous lidocaine as per local practice. A minimum of 2,000 U of intravenous unfractionated heparin or bivalirudin was required for anticoagulation, and a minimum of either 2.5 mg of intra-arterial verapamil or 100 μg nitroglycerin for spasm prophylaxis.

Following administration of local anesthetic, radial access was obtained using a 21- to 22-gauge needle and short hydrophilic sheaths (Glidesheath, Terumo, Somerset, New Jersey). Single- or double-wall technique was used per operator preference. For US-guided procedures, the artery was imaged in the axial plane, and the artery lined up with the centerline of the probe. The needle was inserted at the center of the probe, and the needle tip was imaged by short wiggles of the needle if necessary (**Figure 1**, Online Video 1). Details of the technique have been previously described (11). The guidewire would then be inserted, the skin nicked per operator practice, and the sheath inserted over the guidewire and flushed. Palpation-guided procedures were allowed to cross over to rescue US guidance after 5 min of attempts.

Following the procedure, hemostasis was achieved with the TR Band (Terumo), the D-Stat Rad-Band (Vascular Solutions, Minneapolis, Minnesota), or manual compression. Patent hemostasis and removal of any bands following the procedure were according to local practice. Between 1 and 4 h following the procedure, patient pain levels at the point of radial access were measured using a 0 to 10 visual analog scale. Screening for radial artery occlusion or vascular complications occurred per local practice, including at minimum a pulse check.

Baseline patient demographics and comorbidities were recorded. Peripheral vascular disease (PVD) was defined as having a previous clinical diagnosis of atherosclerosis in a noncoronary vessel, including