

LETTERS TO THE EDITOR

Radial Artery Occlusion: If a Tree Falls in the Forest...

Uhlemann et al. (1) serve all transradial operators with a warning flag regarding the incidence of radial artery occlusion (RAO). Their systematic use of ultrasound to assess for radial artery patency goes above and beyond the typical practice of pulse checks or plethysmography. However, their RAO rates of 13.7% in 5-F sheaths and 30.5% in 6-F sheaths far exceed the rates seen clinically or in recent trials, including those with routine ultrasound screening (2).

A few details are missing that would aid in the interpretation of these results. The duration of radial compression was described as 3 h when this report was presented in abstract form, but was not specified in the publication. RAO was diagnosed by the absence of flow by color Doppler ultrasound, but it is unclear whether this was confirmed by the more sensitive technique of pulse-wave Doppler (where a reversal of flow can be demonstrated). The color Doppler signal in the small radial artery may also be absent if: 1) the ultrasound probe is perpendicular to the direction of flow; 2) excessive pressure is applied; 3) flow is present but reduced in velocity; or 4) the sensitivity is set improperly. Patients with RAO by ultrasound should presumably demonstrate abnormal digital oximetry with ulnar compression—a concordance with this finding would have been helpful.

The use of ultrasound in radial artery catheterization both before and after the procedure should be encouraged. Ultrasound can detect anatomic variants, such as dual-radial systems and radial loops, screen for radial artery calcification, and assess the size of the radial artery. Real-time ultrasound use also facilitates successful radial artery puncture (3).

Unfortunately, formal ultrasound screening for RAO by a trained technician costs up to \$155 (4), which may reduce or eliminate the \$77 and \$184 cost advantage that radial access has over femoral access with and without closure devices (5). The true incidence and impact of RAO will determine whether routine ultrasound screening is necessary or cost effective. In particular, if RAO occurs, and neither the patient nor the physician notices, and there may be a >50% chance of recanalization by 30 days without treatment, does it make a sound?

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Reply

We are grateful for Dr. Seto's letter, because he nicely highlighted the key message of our report by referring to the high rate of radial artery occlusions observed in our prospective registry as "a warning flag" to all transradial operators. It was not our intention to discourage transradial coronary procedures but rather to indicate the need to optimize post-interventional management by closely monitoring radial artery occlusion rates with Doppler ultrasound.

As discussed in our report (1), there are probably 4 reasons to explain the higher-than-expected rate of radial artery occlusions (RAO):

1. Doppler ultrasound is more sensitive than clinical examination only in detecting RAO. We had several patients with retrograde radial artery pulse on clinical examination but RAO as confirmed by Doppler ultrasound.
2. The registry included consecutive patients after transradial procedures performed by both junior and senior staff in the catheterization laboratory—not just patients treated by radial experts—representing a real-world scenario.
3. Looking at the published data, it seems that administration of 5,000 IE rather than 2,500 IE of unfractionated heparin might reduce the RAO rate. In the early days of the transradial approach, Spaulding et al. (2) observed an RAO rate of 71% without heparin, 24.4% with 2,000 to 3,000 IE of heparin, and 4.3% with 5,000 IE of heparin. We increased the routine dose of heparin to 5,000 IE as a consequence of the registry.
4. As reported by Pancholy et al. (3,4), the duration of hemostatic compression after transradial catheterization plays an important role in the occurrence of radial artery occlusion. Arterial sheaths were removed immediately after completion of the coronary procedure. A compression device (RadiStop, St. Jude Medical, St. Paul, Minnesota; or Terumo TR BAND, Terumo, Somerset, New Jersey) was applied to

achieve hemostasis for 3 hours. However, radial artery patency during compression was not monitored. As shown by Pancholy et al. (3), documented patency during hemostatic compression with Barbeau's test reduced RAO rate by 75% at 30 days. This is now also standard at our laboratory.

Reducing RAO rates is a process of optimization of all of these factors—operator training, anticoagulation, hemostasis, and post-procedural Doppler monitoring. We agree with Dr. Seto that pre-procedural Doppler might further reduce complication rates by identifying patients with unsuitable anatomy or small vessel diameter.

With regard to his methodological comments on Doppler ultrasound examination, we are of course aware of the pitfalls for false, positive exams (i.e., absence of flow detection in a patent radial artery). In our registry, study all exams were performed/interpreted by a single experienced operator (M.U.) to avoid excessive pressure of the probe and improper settings of color Doppler flow velocities. Patency of the radial artery was assessed by color Doppler ultrasound imaging and measurement of the flow velocity in the proximal, middle, and distal segment of the radial artery. In addition, the same vascular ultrasound studies were performed in the ulnar and brachial arteries. In case of reduced flow velocity of the radial artery, we performed the same examination at the other hand to compare the arterial flow. Radial artery occlusion was always confirmed by the documenting flow reversal by pulse-wave Doppler.

Cost effectiveness of routine Doppler ultrasound monitoring after transradial catheterization is an issue to be addressed in future studies. It depends on the local healthcare system and whether ultrasound is performed by a physician or a specialized technician. However, we believe that, regardless of the cost issues, Doppler

ultrasound is an invaluable tool to monitor true RAO rates during the aforementioned optimization process when starting/expanding a transradial catheterization program.

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