Kinked Catheter Unravelment in the Right Upper Extremity: An Unconventional Solution

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According to the American College of Cardiology's National Data Registry, use of the radial approach in cardiac catheterization has grown from 1% in 2008 to approximately 50% in the United States, with the right radial approach (RRA) being preferred. Historically, operators have worked on the right side of the patient, which has driven this approach. One of the most common issues with the RRA, arising in approximately 25% of patients[1], is right subclavian tortuosity, which frequently hinders a straight route into the ascending aorta (AA). The right subclavian artery arises from the brachiocephalic trunk, with the presence of two consecutive vascular bifurcations at that level. Tortuosity may affect smooth access into the AA, which directly correlates with increased procedural time, operator radiation exposure, fluoroscopic time, dose area product (DAP), and contrast volume.[2-4] Subclavian and innominate anatomical challenges have been previously described and are divided into five subsets: tortuosity, loop, stenosis, congenital aberrancy, and combined challenges.[5] One of the byproducts from right subclavian tortuosity is kinking or knotting of the catheter from increased manipulation. Operators (especially those in training) frequently over-torque catheters in an attempt to achieve selective coronary engagement.

Case Presentation

A 93-year-old male who had been following with cardiology for worsening shortness of breath arrived in our cath lab. He had a history of chronic obstructive pulmonary disease, peripheral vascular disease (PVD), type 2 diabetes, hyperlipidemia, and hypertension. He was seen in the cardiology clinic, as he was only able to walk half a city block before getting short of breath. Additionally, he had been experiencing worsening lower extremity edema, but no chest pain at any time. He was sent for an echocardiogram that demonstrated an aortic valve area of 0.75cm^2, peak velocity of 4.0 m/s, and a mean gradient of 37 mmHg with a left ventricular ejection fraction of 56-60%. He was worked up for transcatheter aortic valve replacement (TAVR) and as part of the workup, was sent for a coronary angiogram that revealed hemodynamically insignificant coronary artery disease.

Technique

The patient was extremely jovial upon entering the room and joked with staff, establishing an immediate rapport.

After access into the RRA, a 5 French Tiger Catheter (Terumo) was passed into the AA with moderate ease; however, the catheter crossed the trachea under fluoroscopy, noted immediately. This offered an indication of tortuosity aside from underlying clinical factors (age +65, hypertensive, short stature). Prior to engaging the coronaries, with the catheter sitting just at the sinotubular junction, we took a quick "flouro store" of the tortuosity in left anterior oblique/caudal views in order to adequately delineate the tortuosity and document it for any subsequent catheterizations. We found a tight subclavian loop (Figure 1) that proved to be problematic for the procedure. After several minutes of catheter manipulation, no further torque was being transmitted to the tip of the catheter and contrast was unable to be injected, with an altered aortic pressure waveform. We scanned the catheter through the upper vasculature and found the catheter was kinked in the distal right subclavian. A standard J-wire was introduced into the catheter to attempt to straighten the kink, to no avail. After further manipulation trying to unravel the kink, it moved into the mid brachial artery (Figure 2A-B). A hydrophilic Glidewire (Terumo) was then utilized, with the same results. We thought a possible solution would be to obtain femoral access, snare the catheter from the distal tip, and unravel the catheter; however, with the patient being pre-TAVR with PVD, we sought to avoid femoral access unless all other options were exhausted. We also postulated the use of this technique from the left radial, but with the degree of tortuosity and the tip of the catheter sitting distally in the right subclavian, the attending physician thought it would be a monumental feat.

After further consultation with the attending, we decided to use an unorthodox technique to untangle the catheter. With the kinked catheter sitting in the mid brachial artery, the technologist would apply pressure to the brachial artery proximal to the kinked catheter and simultaneously have the attending physician un-torque the catheter to straighten it.

We felt that due to the patient's body habitus and palpable arteries, there was a good chance of success. The team's extensive knowledge of vascular anatomy played a large role in this decision. We knew the brachial artery to be palpable on the anterior aspect of the elbow, and medially/inferiorly to the

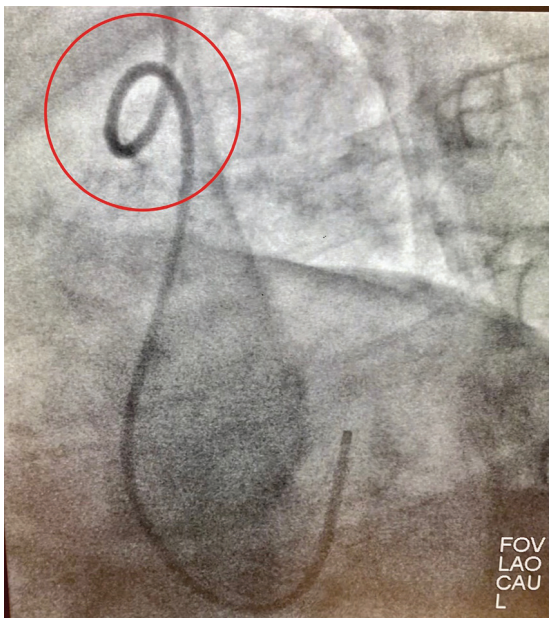

Figure 1. Severe tortuosity of right subclavian artery with loop at aorto-innominate junction.

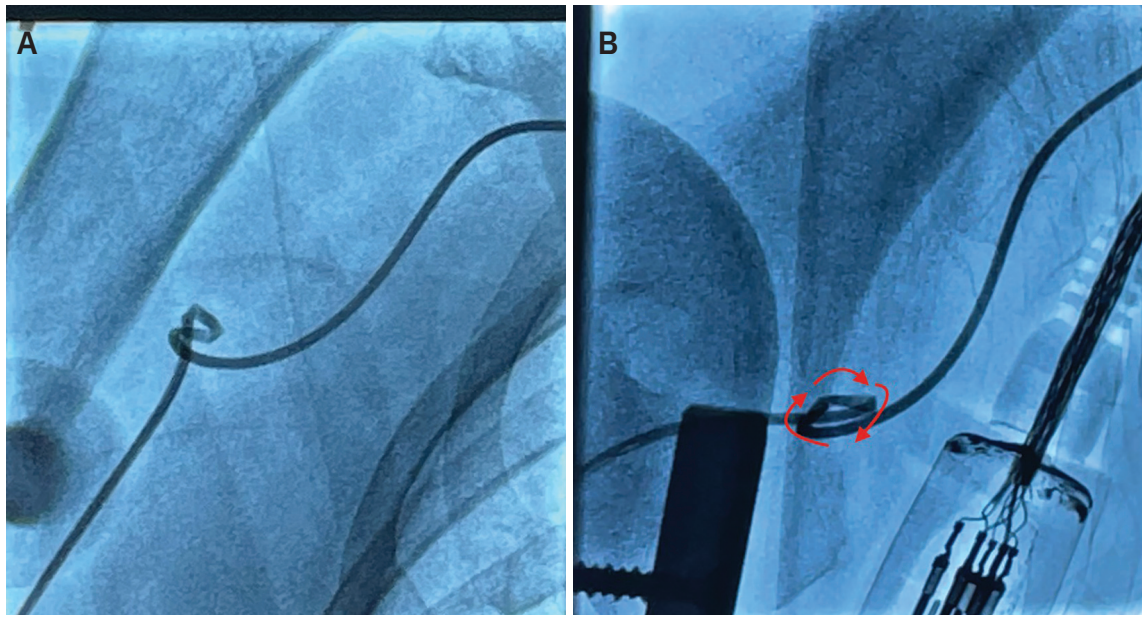

Figure 2A-B. Tight kink in catheter in right upper extremity.

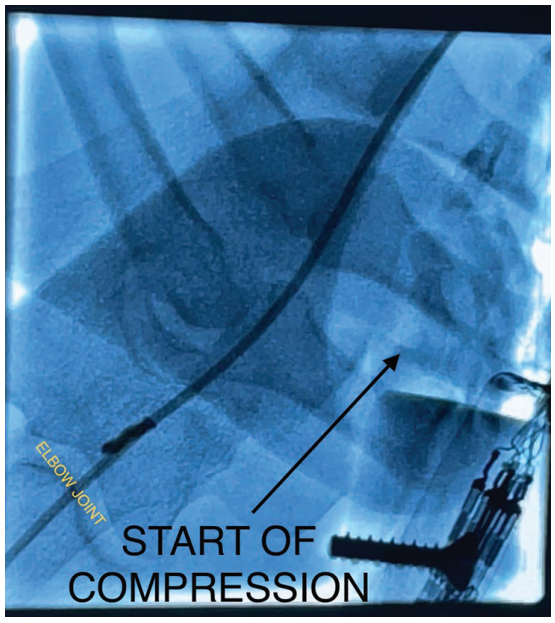

Figure 3. Start of compression with tight kink.

Figure 4. Full compression proximal to kinked catheter.

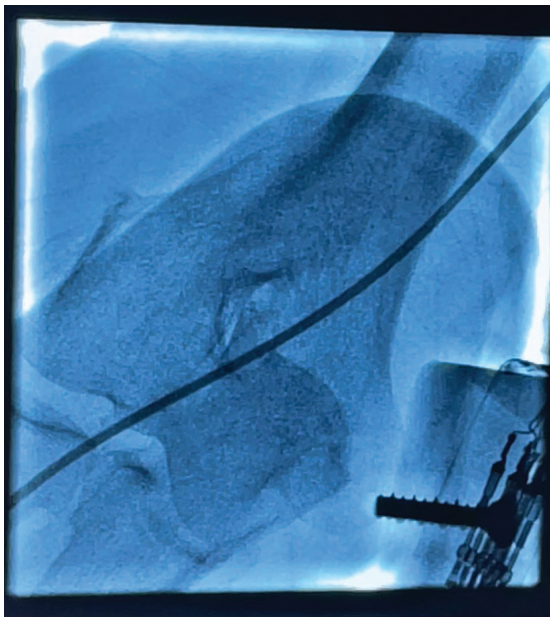

Figure 5. Fully unraveled catheter.

Figure 6. Distal left radial access to complete the case (note use of the Radial Access Sleeve [RAS, Tesslagra Design Solutions]).

bicep tendon. The patient also had poor muscle tone, which helped in applying more direct pressure to the brachial artery, rather than muscle.

Unfortunately, the technologist would need to be close to the radiation source in order to help the patient, as well as have both hands in the primary radiation beam. After convening, we decided to attempt this technique with the use of minimal intermittent fluoroscopy and proper radiation protection. Regrettably, we did not have lead gloves available (which may or may not help with shielding, being in the primary beam). Under fluoroscopy, the kink was moved to the distal brachial artery very carefully while confirming the patient did not have pain in the arm. Once the catheter reached the distal brachial artery, under fluoroscopy, the technologist compressed the brachial artery with significant pressure proximal to the kink (Figures 3 and 4A-B). The attending physician un-torqued and simultaneously pulled the catheter (Figure 5). Within seconds, we resolved the issue safely and efficiently. We aborted the RRA access site, cannulated the left distal radial artery (Figure 6), and completed the case.

Conclusion

Radiation is cumulative and as such, should be treated with the utmost precautions. This technique should not be routine practice in the cath lab. Although it worked well for our patient, cath lab operators and staff should be extremely hesitant to use this technique. It was used in our case as a last-ditch effort to avoid femoral access and a high likelihood of increased catheter manipulation if we had chosen to snare the distal end of the catheter from the left radial approach. Ultimately, the pressure was held for 12 seconds using intermittent fluoroscopy; however, it could have taken a much longer time, which could have altered our technique to unravel the kink. Thankfully, there was no significant change in the radiation dosimeter to the technologist that month as compared with previous months. ■

COMMENTARY

Morton J. Kern, MD

The Maimonides Medical Center team presents a case of a kinked radial catheter in an elderly man with significant shoulder vessel tortuosity. Several considerations to avoid such a problem should be remembered. For short people (5'5") or under, we recommend left radial access. Even with left radial access, a catheter may kink. Given the tortuous path and visualization of the loop, the operators should be aware that vigorous manipulation will likely produce a kink, heralded by the loss of aortic pressure signal. Furthermore, when torquing the catheter produces no response in such a tortuous vessel, the operators may consider inserting a guidewire (before the kink occurs) and torque with the guidewire in place to move catheter toward the target area. However, once the kink has occurred, do not pull it into the arm to try to unkink it.

There are several ways to unkink the catheter once lodged in the brachial artery. These include obtaining alternate arterial access, snaring the catheter centrally, and retracting it. Another way would be to lock the catheter into the brachial artery, as in this case, with either a blood pressure cuff inflated to high pressure, then unkink the catheter, or compress the artery in the manual mode, as was done here.

We should all consider the radiation exposure needed with the last maneuver and whether full-time fluoroscopy for the unkinking maneuver is needed.

The team did the right thing to help the patient at the risk of more radiation. The technologist (and team) might check his radiation badge for this quarter and see if he can proceed to work close to the tube or will need to move to the circulatory position for a while.

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Disclosures: Richard Casazza, MAS, RT(R)(CI) reports he is Director of R&D for Tesslagra Design Solutions. Enrico Montagna, RT(R)(CI), Dr. Miller, Dr. Jayanti, and Dr. Malik report no conflicts of interest regarding the content herein.

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