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Insertion Site Dilemma: Rethinking Radial Arterial Catheter Placement for Device Resilience

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ABSTRACT: The study by Marie et al (2023) discusses their outcomes regarding the distance of radial arterial catheters from the radiocarpal joint and its association to device failure, although authors found no significant difference in failure rates between catheters inserted proximally or distally to the radiocarpal joint. However, other recent studies have reported that catheters inserted more distally are more likely to fail, with rates high as 25%. Factors that contribute to failure include poor site selection, infection, device occlusion, or dislodgement. With reliance on accurate hemodynamics from arterial catheters, providers should be aware of the risks and take steps to minimize them, as catheter failure is more than just associated infection, the inability to aspirate blood or a useable arterial waveform. Optimal insertion location, use of ultrasound-guided techniques, appropriate securement, and close monitoring of the catheter, along with accurate reporting of failure reasons, will help clarify future research outcomes.

KEYWORDS: device-associated failure; outcomes; radial artery catheterization; radiocarpal joint; ultrasound

To the Editor:

We recently read the study from Marie et al (1) on their recent findings regarding the distance of radial arterial catheters from the radiocarpal joint and its association to device failure. We applaud the authors in stating that ultrasound permits the radial artery to be approached along its greater length in the forearm, improving overall insertion successes and efficiencies and reducing patient harm. While the study by Marie et al (1) reported a nonsignificance between both study groups, the prevalence of radial arterial catheter failure is reported to be as high as 25% (2, 3). Despite the authors' claim of being the first study investigating the association between radial artery catheter position and failure reduction, other contemporary articles have already described these device-associated failures, including loss of catheter function, lack of blood return, compromised arterial waveform quality, and catheter dislodgement (4), with failures caused from accidental removal, device-associated occlusion or dislodgements, which directly impacts continuous monitoring and requires additional resources for replacement of the device (4–8).

Marie et al (1) stated that early arterial catheter dysfunction was reported at 23% from the 2015 CLEAN study (9); however, there was no other incidence of device-associated failures reported other than catheter-associated bloodstream infection, less any controllable human factors. The authors have distorted this rate, as the study evaluated differences between two skin antiseptic agents across multiple intravascular devices that were pertinent to infectious

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complications only. Furthermore, the 2021 CLEAN 3 study evaluated short-term peripheral IV catheters (PIVCs) only (10), and device failures were considered as any premature removal of peripheral venous catheters before the end of treatment, other than for routine replacement (whichever presented first) (8), but also none relating to any modifiable human factors. While the study by Marie et al (1) included time from device insertion to failure, it may not be truly representative when comparing multiple anatomical PIVC insertion sites to the radial artery's singular location.

The primary endpoint of the study by Marie et al (1) was the prevalence of catheter dysfunction leading to catheter removal, defined as the inability to perform blood sampling and/or to obtain an interpretable blood pressure waveform from an arterial catheter inserted less than or greater than 4 cm from the radiocarpal joint (1). While these are certainly partial elements of catheter dysfunction, several secondary endpoints are less relevant to device-associated failure, such as the time required to complete the procedure successfully, and staff and patients' satisfaction, despite the advantages offered by a more proximal insertion site (a more stabilized dressing area, not influenced or limiting wrist joint movements for patients during rehabilitation) which have limited impact on actual device failure. While infection is clearly influenced by the use of ultrasound, the number of skin puncture attempts, insertion location in an area of flexion, and occlusive thrombosis, currently reported failure rates may be significantly greater in a wider context.

Several publications have recently drawn attention to easily modifiable factors that are influential in preventing arterial catheter failures (4–7) such as increasing the proximal distance from wrist, routine use of ultrasound, appropriate catheter-to-vessel ratio, lower angles of insertion, extending indwelling device length, together with choice of catheter materials (5). In addition to these procedural aspects, the accuracy in standardized reporting of these factors is an important approach in understanding the true manifestations of device-related failures. Both the RADIALS and arterial insertion method strategies provide clinicians with a blueprint to prevent unnecessary device failures that are easily implemented (5, 7). Infection may certainly lead to unanticipated and early device removal and replacement, however, would this be considered a failure of the device itself? This could be viewed as a potential failure of the inserting clinician to place the device at a more stabilized and appropriate area, avoiding areas of flexion which increase device movement, and along with the use of physical wrist restraints, are well-known precursors to increase localized bleeding, increased dressing disruption, and catheter dislodgement, all significantly impacting device infection and co-related failures.

Clinical researchers need to clearly address the definitions of catheter failure as more than just associated infection, the inability to withdraw blood or provide a useable arterial waveform, and future research remains indispensable. Accurate reporting of why these devices fail will help clinicians have greater insight and appreciate that evidence-based practice changes are necessary to change clinical outcomes for the better.

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