Learning From Others:

A Case Report From the Anesthesia Incident Reporting System

Anesthesia Quality Institute
ANESTHESIA INCIDENT REPORTING SYSTEM (AIRS)

Review of unusual patient care experiences is a cornerstone of medical education. Each month, the AQI-AIRS Steering Committee abstracts a patient history submitted to the Anesthesia Incident Reporting System (AIRS) and authors a discussion of the safety and human factors challenges involved. Real-life case histories often include multiple clinical decisions, only some of which can be discussed in the space available. Absence of commentary should not be construed as agreement with the clinical decisions described. Feedback regarding this article can be sent by email to **airs@asahq.org**. Report incidents or download the AIRS mobile app at **www.aqiairs.org**.

Case 2017-10: Wrong Place, Wrong Time

"Pt admitted to ICU from floor with I.V. in dorsum of hand. Nurse noted pulsating bubble in I.V. tubing distal to pressure lock. Blood gas sent, arterial location of catheter confirmed, catheter removed and pressure held. Unclear what medications were given and fingers appeared normal."

Discussion:

Although it seems unlikely that a peripheral intravenous catheter (PIV) mistakenly placed into the artery could elude immediate detection, the location and patency of any PIV is often difficult to detect. It is likely that every anesthesiologist has encountered a patient with an infiltrated I.V. at least once, often frustratingly in an arm that is tucked or otherwise inaccessible. Although pain on injection, failure of the I.V. to drip freely and/or a swollen injection site are potential signs of a misplaced peripheral I.V., no foolproof method exists for verifying that the I.V. is misplaced. Abundant anecdotal evidence instead suggests that an infiltrated I.V. may drip freely, that the insertion site may not clearly be swollen and that pain on injection may not be present. Instead, the abnormal location may often first be suspected when a drug is given and the patient fails to respond. An absence of blood return when opening the I.V. line to air at a level below the insertion site or aspirating from the catheter also suggests a nonfunctioning PIV. Intraoperatively, an inability to directly visualize the site, such as when arms are tucked, increases the risk of not detecting an I.V. malposition.

In this case, the I.V. was not infiltrated, but in a more dangerous intraarterial location. Such a location would have failed detection by many of the above strategies. For example, because

the catheter was intravascular (albeit intraarterial), a measurable response to drugs commonly used in the hospital such as heparin or insulin would have occurred, preventing detection by non-response to drug administration. In fact, case reports suggest that fentanyl and pancuronium may be clinically effective when given intra-arterially.[1] Also, blood would have freely aspirated from the catheter, preventing detection by failure to aspirate blood. Although arterial pressure would have generated detectable backpressure in the I.V. tubing, the increasing use of infusion pumps to deliver nearly all intravenous medications on a hospital floor removes opportunities for abnormal tactile feedback by experienced caregivers.

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Further compounding the difficulty of using elevated intravascular pressure to detect an inadvertent intraarterial PIV is the increasing use of "claves" to facilitate connecting and disconnecting intravenous lines. These devices are usually attached to a short length of tubing that connects to the I.V. catheter and allow the patient not to be tethered to an I.V. when not receiving fluids or medications. Claves prevent fluid passage by "locking" when not attached to an I.V. connector, and in this case may have hindered detection by not allowing blood to reflux into the I.V. tubing under arterial pressure. Detection of this intraarterial PIV occurred because an experienced ICU nurse noticed a small air bubble pulsating in the short segment of I.V. tubing between the clave and catheter. It is easy to imagine that a less experienced or observant caregiver may have missed such a subtle finding or not suspected that the I.V. location was arterial.

As with malpositioned PIVs in general, the incidence of inadvertent intraarterial PIV insertion is difficult to estimate. Reporting systems may not easily capture such events as they may be identified before they cause clinical harm, or when the case is transferred to and from the perioperative and hospital settings. A search of the AIRS database from 2011 to 2017 found three reports of infiltrated I.V.s and one additional report of a (femoral) intraarterial I.V. out of 1,469 event reports. Over the same time period, 36 of 1,242 reports to the University of Chicago Department of Anesthesia focused on infiltrated I.V.s.

Intraarterial I.V.s are likely rare since most I.V. inserters target specific veins visible or palpable through the skin, and insertion sites where a targeted vein lies sufficiently close to an artery to allow an intraarterial malposition are uncommon. Nevertheless, such malpositions have been previously described. A 2002 case series[2] reported two cases where an I.V. placed into the dorsum of the hand was intraarterial. One was detected when flushing the poorly running I.V. caused concurrent pressure changes in an arterial line placed on the same side, and the other was identified by pulsatile retrograde flow. Another 2004 report studied the vascular anatomy of 26 cadavers[3] and found that two had radial arteries sufficiently superficial that confusion with the cephalic vein could result. Along with other reviews of arterial cannulation,[4] these reports describe several vascular abnormalities that predispose to this malposition, including superficial radial arteries, "antebrachialis superficialis dorsalis" (early bifurcation of the radial artery and an incomplete palmar arch) and an abnormally superficial ulnar artery.

Consequences and treatment of intraarterial injection are also described in the above reports. Intraarterial injection may result in flushing, mottling, paresthesias, motor abnormalities and vascular compromise. Regional pain syndromes and severe soft tissue damage may also result. Treatment is largely empiric and should focus on pain relief, anticoagulation, relief of vascular spasm if present and treatment of soft tissue damage. In this case, luckily, no damage to the hand or fingers occurred.

The malpositioned I.V. presents a frustrating, challenging and underreported problem for the anesthesiologist. Although no foolproof method for identifying malpositioned I.V.s exists, a high degree of suspicion, abnormalities in fluid flow, swelling or redness at the site, and pain on injection should trigger further inspection. Free flow or aspirated blood from the catheter identifies an intravascular location. As in this case, however, a location on the dorsum of the hand does not rule out an intraarterial location. For those interested, an ASA-sponsored online educational module focuses on I.V. infiltrations and extravasations.[5] Ultimately, vigilance is the most important weapon in the anesthesiologist's defense against the infiltrated I.V.

References:

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3. Lirk P, Keller C, Colvin J, et al. Unintentional arterial puncture during cephalic vein cannulation: case report and anatomical study. *Br J Anaesth.* 2004;92(5):740-742.
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