



A Case Report From the Anesthesia Incident Reporting System

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 the AIRS Committee: airs@asahq.org. Report incidents or download the AIRS mobile app at www.aqiairs.org.

Case: Down to the wire

A 65 year old male scheduled to undergo a CABG for three vessel CAD required a central line for monitoring and medication administration. A resident placed a central line under the direct supervision of the anesthesiologist, who scrubbed out and stopped immediate observation of the procedure after ultrasound confirmation of the J-wire in the vein. On postoperative day 7, a CT scan demonstrated that the J-wire was in the vena cava. All postoperative chest radiographs were read as "tubes and lines in usual position." The retained wire was missed by the critical care, surgical and radiology services for one week. Upon reviewing the CT scan results, the cardiothoracic surgery resident informed the anesthesiologist of the retained wire. The anesthesiologist spoke with the patient, his wife and the surgeon, wrote a note in the chart and accompanied the patient to Interventional Radiology for percutaneous removal of the J-wire, which was uneventful. The patient was very understanding.

Discussion:

The placement of central venous catheters is essential to the management of many patients in both the operating room and the intensive care unit. The complications of central venous catheter placement are well documented and include infection and damage to the vein or surrounding structures, most notably arterial puncture injury and pneumothorax.¹ Retained guidewires have received less focus, but constitute an important complication of central venous line placement.

The exact incidence of retained guidewires is unknown, but some evidence suggests a rate of one case per a few thousand catheter insertions.² The symptoms caused by retained guidewire depend on the site of insertion and the location where the guidewire ultimately lodges. In critically ill patients, nonspecific findings related to retained guidewires, including pain, limb swelling, leukocytosis and fever can often be overlooked or attributed to other factors.³

Delay in diagnosis is a serious problem for retained guidewires. While a significant percentage of retained guidewires are recognized during line placement (26.3 percent) or within hours of the procedure (22.4 percent), the remainder are not recognized for

days, as was noted in our case, or even years.³ Retained guidewires can be missed on imaging for many reasons including position in an area not covered by routine chest radiograph (for example, a wire lodged in the IVC or femoral vein), low quality imaging and the distraction by or superimposition of multiple other lines, tubes and packing.^{2,3} Even when the retained guidewire is clearly visible on chest radiograph, its presence can be missed by multiple readers focusing on other findings.^{2,3} Once discovered, most retained guidewires are removed by percutaneous methods, but may require surgical exploration or may not be amenable to removal due to location or state of the guidewire.³

Of the 25 cases noted in a 2013 review of the American Society of Anesthesiology Closed Claims database related to retained wires/embolus, there was one death and one disabling injury.² Complications of retained guidewires noted in case reports include retroperitoneal hematoma, perforation of the gallbladder, perforation of the atrium or ventricle leading to tamponade, thromboses including pulmonary embolism, vertebral artery thrombosis, lower limb thrombosis and infectious complications including abscess, endocarditis and intra-abdominal fluid collections.³ Symptoms, if present, can be delayed for months or years. For example, a retained guidewire lodged from the SVC to the right external iliac vein came to attention 17 months after insertion during a workup for chest pain and palpitations.⁴

Many conditions leading to guidewire retention are similar to those leading to other adverse events, including high workload, operator fatigue, emergency situations, off hours and inexperience.^{2,3} Others more specific to central line placement include a "double stick" where two kits are present for two lines.² Patients undergoing central line placement are often critically ill, and the simultaneous management of unstable hemodynamics can distract from supervision and placement of central lines.^{2,3} Simultaneous procedures, such as TEE, can be distracting as well.^{2,3} Making decisions regarding other sick patients during line placement was also a factor.³

We know of no evidence-based recommendations demonstrated to decrease the incidence of retained guidewires during line placement (likely because of the very low incidence). Thus, any recommendations can only come from “common sense” based on the likely causes of the event. Using James Reason’s Swiss cheese model,⁵ lack of supervision, lack of confirmation of guidewire removal, and missed radiology findings all aligned to allow a retained guidewire to remain in place for one week in this case. First, the resident was unsupervised after wire placement was confirmed in the vein. Given the possible complications of retained guidewire (or other events that can occur at this point, e.g. dysrhythmia), it is not unreasonable to consider adding removal of the guidewire to the list of critical steps that should be supervised during placement of a central line. Creating this expectation should be done as a way to reinforce the “team” nature of these types of safety events, not to blame the trainee or supervisor. Second, after placement, there was no checklist used or verbal confirmation that the guidewire had been removed. A checklist for line placement has been demonstrated to improve clinician adherence to best antiseptic practices and to decrease central line infection,⁶ and its use is now a national standard. Consideration might be made to include technical items such as removal of the guidewire on the central line checklist, in addition to those designed to prevent infection. Finally, the retained guidewire was missed multiple times on routine chest radiographs until it was noticed on CT. Detection and mitigation of this, though, is beyond the scope of this particular review.

Many aspects of this case went very well. Once the finding was recognized, there was prompt communication from the cardiothoracic surgery team to the responsible anesthesiologist, and from the anesthesiologist to the patient and to the interventional radiology team. When an error has been made, disclosure to the patient can be very difficult and hampered by concerns about blame and legal consequences.⁷ After an adverse event, patients typically want a clear explanation of the error, why it happened and how further errors will be prevented, as well as an apology.⁶ In this case, the error was communicated to the patient and, while we don’t know the details of the discussion that took place, the patient seemed satisfied with the disclosure. The anesthesiologist also accompanied the patient to interventional radiology for the guidewire removal procedure, which likely put the patient at ease at a stressful time and showed a tremendous commitment to continuity of care.

Many institutions have protocols in place to prevent guidewire retention through procedure checklists.^{2,3} Other strategies to prevent retained guidewires include a strict guideline of limiting wire insertion to the 18-20 cm mark, keeping hold of the wire with one hand at all times, or changing the design of the central line to include a different color or consistency of the last portion of a guide wire.³ Counting surgical items is an essential safety step for our surgical colleagues, and an independent count by nursing or anesthesia staff, especially with multiple kits and lines, could be an important safety step in central line placement as well.^{2,3} From a training standpoint, ensuring that trainees, both

in anesthesia and in radiology, are aware of the potential for retained guidewires and supervised during all critical procedures, and high acuity and risk periods may also improve patient care.^{2,3}

In his book *Normal Accidents*, Charles Perrow postulates that human error/accidents cannot be completely eliminated, only the time between events shortened or lengthened.⁸ Pertinent to this report of retained guidewire, Vannucci and colleagues reported a series of four retained guidewires associated with central line placement, two of which occurred after development of a specific protocol and extensive training.² The last two events occurred with anesthesiologists who had completed the training course. Reduction of any adverse event requires continual attention and review of processes, not just development of a protocol. In summary, implementing safety protocols proven in other situations, such as including removal of wires on checklists, expanding counting procedures, increasing expert supervision, and regular review of procedures to maintain the necessary vigilance can reduce the risk of a retained guidewire.

References:

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