Learning From Others:

A Case Report From the Anesthesia Incident Reporting System

Anesthesia Quality Institute
ANESTHESIA INCIDENT REPORTING SYSTEM (AIRS)

Detailed review of unusual cases is a cornerstone of anesthesiology education. Each month, the AQI-AIRS Steering Committee will provide a detailed discussion based on a case submission to the Anesthesia Incident Reporting System (AIRS). Feedback regarding this item can be sent by email to **r.dutton@asahq.org**.

Report incidents in confidence or download the free AIRS mobile application (Apple or Android) at **www.aqiairs.org**.

Case 2015-1: Missed Connections

"There is no body cavity that cannot be reached with an 18 gauge [catheter] and a good strong arm."

– The House of God, Law #6, by Samuel Shem

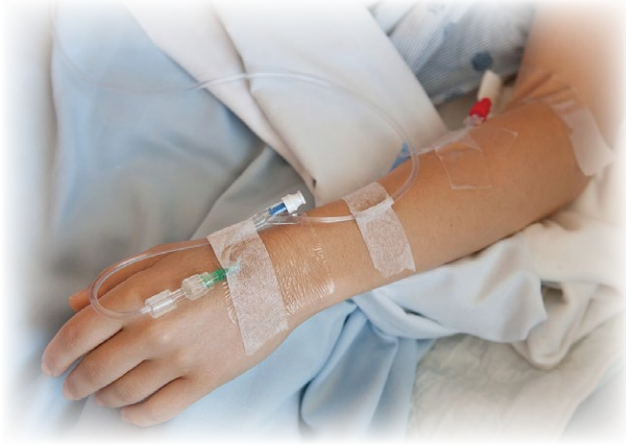
Case Presentations

#1: *The patient came to MRI with a peripheral I.V. in one hand and an arterial line in the other hand. Both were heavily dressed. I hooked up the I.V. fluids to the arterial line. I realized my error before opening the fluids, so nothing reached the patient.*

#2: *A patient with a history of obesity, OSA, HTN and diabetes was taken to the O.R. for right hemicolectomy. An epidural catheter was placed preoperatively for post-op pain management with bupivacaine 0.1 percent and fentanyl 5 mcg at 5ml/h. Overnight, epidural orders expired and the surgery resident wrote orders to stop the epidural and start I.V. PCA. The next morning the patient was found to be somnolent, with an arterial oxygen saturation of 60 percent, as a result of hydromorphone infusion into the epidural catheter. The patient received 10 times the normal dose of epidural narcotics and was in respiratory acidosis with atelectasis on CXR requiring naloxone rescue and overnight mechanical ventilation.*

#3: *A 34-year-old woman, G3P1 at 38 weeks, presented for repeat caesarian section. An epidural catheter was placed with difficulty and dosed with chloroprocaine 3 percent with HCO3 and lidocaine 2 percent. During this time, the patient inadvertently received clindamycin 90 mg (3 ml) through the epidural catheter due to similar appearance of the local anesthetic and clindamycin syringes (20 ml syringes with orange labels). The patient experienced no adverse effects in the perioperative period.*

#4: *Ephedrine 2.5 mg was injected into a port on tubing that the ophthalmologist had inside the patient's eye for a vitrectomy. This was recognized immediately and no drug reached the patient.*



Discussion

In the past 100 years, medical science has found a way to place a catheter into virtually every cavity of the body. We have at our disposal a myriad of beneficial and harmful pharmaceutical solutions that are lifesaving by one route, but lethal by another. Despite the importance of matching the solution to the route of infusion, we have managed to make every possible misconnection between infusion type and access line, often with disastrous outcomes.

These erroneous medical connections have been a threat for far too long. One lethal type of misconnection (e.g., nitrous tank connected to oxygen line) was recognized and corrected 50 years ago with the advent of unique pin index valves for each type of medical gas. These unique connections were developed and mandated by the International Organization for Standardization (ISO). We have been far more derelict with the issue of Luer locks, or what the FDA terms "small bore connectors." These are ubiquitous and are used for virtually all systemic injections or infusions, with the result that virtually every wrong connection that could be made has been made (Table 1, page 43).

Table 1: Types of Misconnections (JC Sentinel Event Alert 363)			
Enteral feed solution	TO	I.V., central line, hemodialysis	116 reports, 21 deaths known, underreported
Epidural infusion	TO	I.V.	Bupivacaine deaths
Blood pressure cuff	TO	I.V.	Air embolism, multiple deaths
I.V.	TO	Nasogastric tube	
I.V.	TO	Epidural	Dopamine, epinephrine
Syringe bolus	TO	Epidural	Antibiotics, NMB, narcotics, sedatives
I.V. solution	TO	Arterial line	Relatively easy to detect
Syringe	TO	Arterial line	Wide variety of drugs
I.V. solutions	TO	Foley, dialysis lines, ventriculostomy port, tracheal cuff	
Capnography sampling	TO	I.V.	
O_2 tubing	TO	Needless I.V. port	Potential air embolus
Pneumatic stockings insufflation line	TO	Piggy-back port of I.V.	Air embolus

Unintended injection of drugs into the neuraxial space has typically had the most devastating outcome. The first report of a death due to accidental infusion of vincristine into the intrathecal space was in 1968; since then, despite extensive publications, there have been at least 58 deaths worldwide, with many more likely unreported.[1] In addition, enteral feeds (meningitis and death), chlorhexidine (death of a parturient) and formaldehyde (death) have all been given intrathecally.[2,3]

The reverse, i.e., neuraxial solutions intravenously, has also been lethal. One of the most widely reviewed cases of misconnection involved a pregnant 16-year-old in labor with an epidural. Two bags for infusion were delivered to the labor room, penicillin for the I.V. and bupivacaine for the epidural. The nurse connected the bupivacaine to the I.V. and delivered it, free flowing; the young mother arrested and died (the baby was saved). The nurse was charged with a felony, which was the second tragic event.[4] Connecting the Luer-lock fitting on an automated blood pressure cuff to an intravenous line has also produced a tragic event.[5]

Given the complexity of the anesthesia or critical care environment, the wonder is not that these events occur, but that they do not occur more often. Using the same connectors for a myriad of access lines makes this a perfect example of what Dr. James Reason calls error traps:

"The same situation keeps producing the same errors, even though quite different people are involved. That surely indicates we are dealing with error prone circumstances rather than error prone people. We are dealing with error traps."

Indeed, it is remarkable that serious outcomes do not occur more frequently. In an observational study, Cook and colleagues found 108 complications in 700,000 neuraxial blockades; of the 108, 11 were wrong route (.0016 percent incidence), and one was fatal.[6] In the Australian Incident Monitoring System, incorrect route accounted for 14.1 percent of the 896 medication incidents reported.

Despite widespread recognition of the great potential for error, and the obvious and simple solution (different connectors for different routes), most attempted fixes, including many sets of guidelines (Table 2, page 44), involve labeling, retraining, in-services and education with exhortations to "be more careful." These solutions are only weakly effective in preventing human errors.[7,8] Mistake-proofing requires system design changes that force correct actions. Despite the number of deaths associated with connection errors, the Institute of Medicine does not mention requiring manufacturers to design and implement

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unique connectors for each access location. In 2011, the NHS set a mandate that neuraxial systems have unique connectors, but was forced to delay the mandate when the early designs were unacceptable to physicians.[1,9,10] One significant issue raised by U.K. anesthesia societies was that each neuraxial system used a different design for the connector, rather than a single unique connector designated for neuraxial use.[11] This would be the equivalent of each gas manufacturer having a different proprietary pin index system.

This issue is now, thankfully, being resolved. The ISO has set ISO 80369-1(general requirements) through 80369-7 for small-bore tubing and connectors, with the intent that unique small-bore connectors will be engineered for each system (80369-2 for gas and breathing devices, 80369-3 for enteral, -4 for urinary, -5 for limb cuff, -6 for neuraxial, and -7 for intravascular). The first ISO connector standard is directed at enteral feeding systems and has been adopted. These standards involve both the connection with the enteral feed and the connection to the gastric tube (Figure 2 A, B, page 45). Launch of the various components of the system are scheduled from October 2014 through September 2015. The state of California has mandated adoption of the new connector systems as they become available. The neuraxial connector changes are anticipated to begin in Q3 2015 and continue through Q2 2016. Although the neuraxial connector design is not finalized, it is likely to use a smaller bore than that for intravascular systems and to reverse the male-female connection.

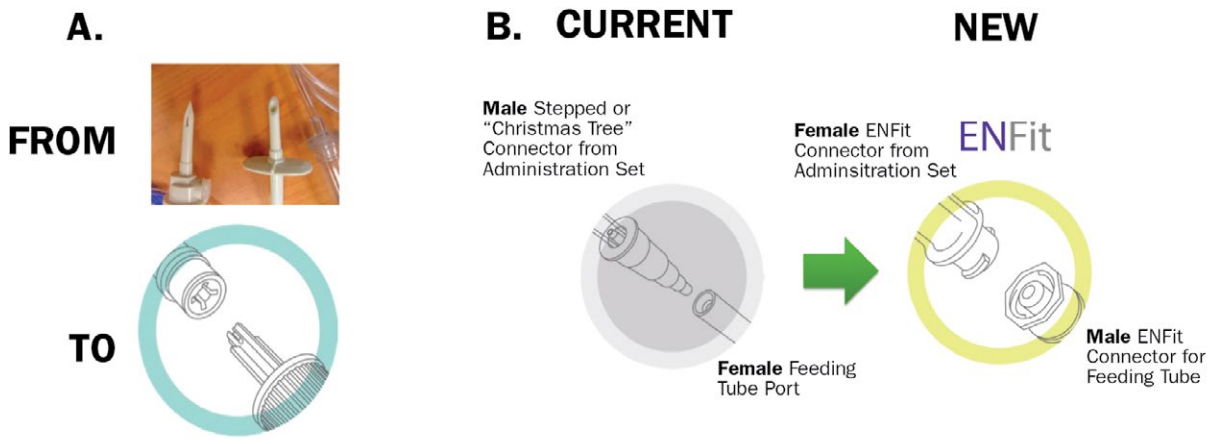
These connection changes are critical and long overdue. Unfortunately, there will be many more opportunities for us to make errors and injure patients before unique connectors are widely available; in the transition period before these unique connectors are available, the Joint Commission has released a set of recommended practices to be adopted during the transition to new ISO connector standards.[12]

Of course, any change in existing systems – even one for the better – has the potential to paradoxically increase adverse events in the short term. The unintended consequences of the change to unique device connectors are as yet unknown, but it

Table 2: Existing Guidelines or Recommendations

	ISMP	JC	APSF	ISO
Route-specific connection methods, including unique tubing, connections			X	X
Label every line with the access type (proximal, distal and at each stopcock)	X	X	X	
Use color-coded labels to enhance recognition: arterial – red, venous – blue, neuraxial – yellow, enteral – green or purple.	X	X	X	
Do not use tubing or catheters for arterial or neuraxial routes that have ports; do not place stopcocks into these lines	X	X		
Use a unique infusion pump for enteral feeds		X		
Use a different type of infusion pump for neuraxial versus venous lines		X		
Do a two-person check when connecting infusion to any line		X		

Figure 2: Proposed Connectors for Enteral Feeding Systems



Used with permission from Global Enteral Device Suppliers Association (GEDSA).

is certain there will be new hazardous situations created when frustrated clinicians attempt to defeat "idiot-proof" systems. It is likely that the overall effect will be improved patient safety through reduction of unrecognized misconnections. However, it will be incumbent upon practicing clinicians to remain vigilant and to report to AIRS problems, complications, near-misses and other events as we transition to these new connectors.

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