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PATIENT SAFETY NETWORK

Central, not Epidural

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The Case

A 55-year-old man with lung cancer recently had the lower lobe of his left lung removed. Post-operatively, he was awake, alert, and oriented to time, place, and person. He was, however, malnourished from his cancer and experiencing significant pain at the surgical site. He had a chest tube and a urinary catheter in place, but was breathing on his own. The patient's pain was well controlled with fentanyl and bupivacaine administered through an epidural catheter. He was receiving total parenteral nutrition (TPN) and lipids through a central venous catheter inserted in his left jugular vein.

Nurse A, assigned to the patient, left the unit for her regularly scheduled break. Before leaving, she prepared a new bottle of lipids and left it at the bedside, as the current bottle would run out while she was off the floor. When the old bottle of lipids was empty, Nurse B, covering the patient during the primary nurse's break, inadvertently attached the new lipid bottle to the Y-site of the epidural tubing rather than the central venous line.

Upon her return, Nurse A noted that the new bottle of lipids was infusing but did not check the lines. Lipids infused into the epidural catheter for several hours. The problem was not discovered until the nurses on the next shift made rounds and checked the patient's tubing. Fortunately, the patient experienced no adverse effects from the infusion of lipids into his epidural space.

The Commentary

This case illustrates a common tubing connection error. Numerous reports have documented unintentional failures to connect the correct tubing between intravenous, epidural, intracranial, intrathecal, gas, and other tubing systems used for patient therapy.(1-5) A recent literature review found 114 case studies in which feeding solutions, intended for enteral routes, were misconnected to intravenous lines.(6) Of these cases, 60 involved adults, and 28 involved children or infants.(7) The United States Pharmacopeia reviewed 300 cases of tubing misconnections in the MEDMARX database.(8) The common element in each misconnection was the Luer tip, or small bore connector, an ever-present universal connector used in health care.

Although the patient in the present case was not harmed, a misconnection of tubing often results in patient death. For example, infusing gases into an intravenous system could cause air emboli, and mistakenly infusing epidural anesthesia intravenously could be deadly. Despite the high stakes, universally compatible Luer connectors are used for different kinds of tubing in most health care settings.

Connecting correct tubes seems like a deceptively easy task to accomplish, making it even more perplexing when a skilled practitioner misconnects tubes after years of correct connections. An initial reaction to a tubing misconnection is to question the carefulness, skill, and vigilance of the clinician. However, the field of human factors explains these errors and offers insights that may lead to solutions.

Tubing misconnections often occur as a result of cognitive "slip" in performance. Reason described how such slips are often associated with practitioners being in "automatic mode," during which familiar tasks are performed subconsciously and skillfully.(9) Performing a tubing connection is a routine, familiar, and common task in nursing, often performed many times on one shift. This means that a "slip" made while connecting tubing is generally not under the conscious control of the health care provider, who may be distracted, stressed, and fatigued.

We guard against slips in other areas of our lives, such as when our car sounds an auditory alarm when keys are left in the ignition switch, when automatic timers shut off clothes irons, and when we purchase medication with childproof lids. Recognizing human limitations allows us to design safety measures to mitigate the risk of human error. Unfortunately, health care, for the most part, continues to rely on human performance despite warnings and admonitions from the Institute of Medicine beginning more than a decade ago.

While a variety of visual cues can alert clinicians to different tubes, if tubing misconnections occur under subconscious control, such cues may not be adequate. For example, some experts have suggested labeling at the proximal and distal end of tubes and color coding, but color coding itself has disadvantages as a defense against error, as colors are not standardized across settings and colors of products often change.(4) Other measures include requiring nurses to trace lines in order to identify the correct tubing, route tubing in different directions, and perform independent double checking and rechecking lines.(3,4,14) The Institute of Safe Medication Practices suggests: (i) always trace the port and tubing back to its insertion site to verify the correct access/route of administration and (ii) never attempt to force or jury-rig a connection that does not fit easily and securely into an access port.(14) (For additional recommendations to avoid catheter/tubing misconnections, please visit the ISMP Web site).

There is a long history of warnings about tubing misconnections.(3,10) The Joint Commission issued a Sentinel Event Alert addressing the danger of tubing misconnections in 2006.(11) Internationally, preventing tubing misconnections is a part of the World Health Organization's "Nine patient safety solutions."(12) The Food and Drug Administration has issued numerous alerts to the public and product manufacturers, health care practitioners, and hospital purchasing departments suggesting ways to prevent catheter/tubing misconnections.(13) The United States Pharmacopeia has issued error avoidance recommendations that ask for a redesign of connectors.(3) Currently, the International Organization for Standardization is writing a standard that addresses the redesign so that systems cannot connect to each other. Designs are expected to be finalized in 2011, and the standards in 2013.(14)

The problem remaining is that these are *voluntary* standards. Many manufacturers have already changed the design of their products to increase safety, but health care organizations must then buy a safer alternative product. Unless an organization recognizes the risk, it may continue to purchase tubes with universal connections. Despite warnings from regulatory agencies, safety organizations, and publications, universal tubing remains more the rule than the exception. This highlights the need for a single national health care safety body to coordinate standards and deliver widespread communication regarding safer health care practices. Unfortunately, without a safety coordinating body, hazards such as this will continue.

Enforcement of these new standards is years away. While we wait, we must increase awareness of human factors and create a health care culture that responds to errors and risks much more quickly. Until then, the seemingly simple act of connecting tubing should be considered a high-risk activity, and providers should act accordingly. High-risk procedures are often mitigated by having two people independently check for accuracy (we already do this for high-risk drugs and surgery site marking in defense of slips). Although independent double checks may represent a big disruption to an already stressed work force, they may be our only defense against cognitive slips until we can redesign connectors to guard against human error.

Take-Home Points

- Relying on vigilance and perfect performance is dangerous.
- Universally connecting systems present a danger for a slip.
- The problem of tubing misconnections points to a need for a national coordinating body for health care safety.
- Independent double checks can defend against human error.

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