Learning From Others: A Case Report From the Anesthesia Incident Reporting System

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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 spsace 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 2018-11: ACDF

A 45-year-old male with cervical radiculopathy presented for anterior cervical discectomy and fusion (ACDF) at C5-C6. Somatosensory-evoked potential monitoring (SSEP), motor-evoked potential monitoring (MEP) and continuous electromyography (EMG) were used. Plan was to limit sevoflurane to about one-half MAC, to avoid the use of neuromuscular blockers after intubation and to supplement with a propofol infusion. During induction, the patient became hypertensive despite greater than usual doses of propofol (450 mg in a 90 kg patient), fentanyl (350 mcg) and intravenous lidocaine (120 mg). Forty minutes into the surgery, the patient again became severely hypertensive and required additional boluses of propofol (total 300 mg). Propofol was running at 100 mcg/kg/min. A number of cuff pressures yielded artifact, interspersed with normal readings. This was attributed to leaning by the surgeon. About 55 minutes into the surgery, the team placed a cuff on the left ankle and asked the monitoring technician to hold twitches. Repeated high pressures were obtained in the 245/115 range. We made sure the arrow on the cuff lined up with the posterior tibial artery. The patient was on 1 percent end tidal sevoflurane and propofol was up to 160 mcg/kg/min. Additional opioid and 20 mcg of dexmedetomidine had been given. Labetalol 20 mg was then given. Pressures became difficult to detect. Pressures were restored with several doses of phenylephrine, vasopressin and fluid boluses. Fifty minutes later, the patient emerged uneventfully and had a normal neurologic exam in the postoperative period.

Discussion

Isolated monitoring artifacts are common. Some artifacts are readily recognizable by their transient nature, their inconsistency with trend and context, and failure to follow known patterns of physiology. For example, a blood pressure of 165/155 represents an impossible pulse pressure. A true desaturation to 70 percent does not bounce back to 99 percent in a second. When it is unclear if a vital sign is a true artifact, the value frequently normalizes so quickly that we move on.

Repeated abnormal values present us with a human factors challenge. It is easy to be lulled into a fixation error, attributing the repeated abnormal values to artifact when, in fact, all is not well. After initially applying pulse oximeter sensors to different fingers and calling for replacement cables, the provider will eventually escape from fixation and accept that a real desaturation is happening. By this time, the opportunity for early intervention may have been lost.[1,2]

In hindsight, it can seem that the physician knowingly made a calculated decision to disbelieve abnormal values rather than accept them. However, the physician did not perceive a fork in the road. “Local rationality” describes the state where behavior is rational when viewed from the actor’s knowledge and focus.[2]

Anesthesiologists can develop effective countermeasures to fixation error. By developing a habit of regularly stepping back to look critically at the bigger picture, fixation errors become more obvious. This habit is a type of metacognition. Another helpful countermeasure is using the anesthesia team to check our work. Team training highlights crosschecking the work and observations of teammates. Carefully crafted simulation scenarios are an invaluable way to improve team training and test our ability to self-detect fixation.

Confirmation bias is another pattern demonstrated in the case vignette. If values that are acceptable alternate with abnormal values, there is a tendency to relax when satisfactory numbers appear and to disbelieve bad values. A rational explanation (such as the surgeon leaning on the blood pressure cuff) makes it more difficult to believe the abnormal values. Our colleagues who reported this case recognized the risk of this error and moved the blood pressure cuff while insisting that bothersome neurophysiologic monitoring stimuli be held for a few seconds. The team was then able to stabilize the patient.

An arterial catheter would have provided continuous blood pressure monitoring, avoiding the artifacts from the blood pressure cuff. We asked the reporting physicians if they had established criteria for arterial catheters in anterior

cervical fusion procedures. Our reporters use an arterial line for patients with myelopathy, procedures involving multiple cervical spine levels or the presence of a relevant co-morbidity. This is a heuristic, practical rule of thumb to facilitate decision-making. We all use heuristics. These mental short-cuts are efficient. They relieve us from having to apply first principles, experimental data (if any) or classical decision-making to every situation.

Artefactual noninvasive blood pressure readings seem to be common in anterior cervical fusion cases, perhaps because the arms are tucked near where the surgeon stands and, perhaps, due to the use of somatosensory-evoked potential monitoring (SSEP). Artifact due to the surgeon's body leaning on the blood pressure cuff also occurs during thyroid and breast surgery, which is why the cuff is frequently placed on the ankle for these procedures. In this case, SSEP monitoring was present, which presents an independent source of NIBP artifact. Although SSEP is a sensory modality, the peripherally applied stimulus leads to twitching of the hand and arm muscles, confusing the automated blood pressure cuff. Anesthesia teams can periodically ask the monitoring professional to hold stimulation.

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Artifacts during anterior cervical fusion surgery can reduce the time to respond to hypotension, which can increase the risk of ischemic stroke.[3] The retractor may disrupt flow in the ipsilateral internal carotid artery (ICA). While auto-regulation curves suggest that a healthy patient should tolerate a mean arterial pressure (MAP) down to 50 without cerebral ischemia, many hypertensive patients have an elevated lower limit. When retraction partially occludes the ICA, the Circle of Willis provides collateral circulation. However, up to half of patients have an incomplete Circle of Willis, and 6-7 percent have no collateral pathway between the right and left circulations. For some of these patients, a MAP of 50 may be lower than the protective range of auto-regulation. Perfusion pressure can be maintained by avoiding persistent hypotension.

There is not enough evidence to insist that every ACDF be done with intra-arterial pressure monitoring, although there are some anesthesiologists who do exactly that. Arterial catheters are expensive, can occasionally take more time than we like to admit and, infrequently, cause their own complications. It was reasonable to begin the surgery reported above without an arterial catheter. However, the procedure offered opportunities to reconsider. When the patient reacted with exaggerated hypertension on induction but before surgery start, an arterial catheter could have been inserted. When the blood pressure cuff showed persistent artifact despite moving the cuff to the ankle, a dorsalis pedis arterial catheter could have been attempted.

After the patient's hypertension was aggressively treated with multiple agents, the patient then became hypotensive. Although the risk of stroke is very small in any particular ACDF patient, hindsight bias would connect the intra-operative hypotension to a postoperative stroke, especially if nothing was done to correct the hypotension. Decreasing the anesthetic agents to lower levels risks patient movement, so vasopressor agents were used to bring the patient back to a normal blood pressure.

The patient completed the anesthetic with no obvious neurological deficits. Despite the good outcome, the case was not as smooth as it could be. The postoperative debriefing provides an occasion to question our heuristics and attempt to look back on the events of the case without the biases described above.[4]

We thank the case reporters for sharing their experiences with us.

References:

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3. Drummond JC, Englander RN, Gallo CJ. Cerebral ischemia as an apparent complication of anterior cervical discectomy in a patient with an incomplete circle of Willis. *Anesth Analg*. 2006;102(3):896-899.
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