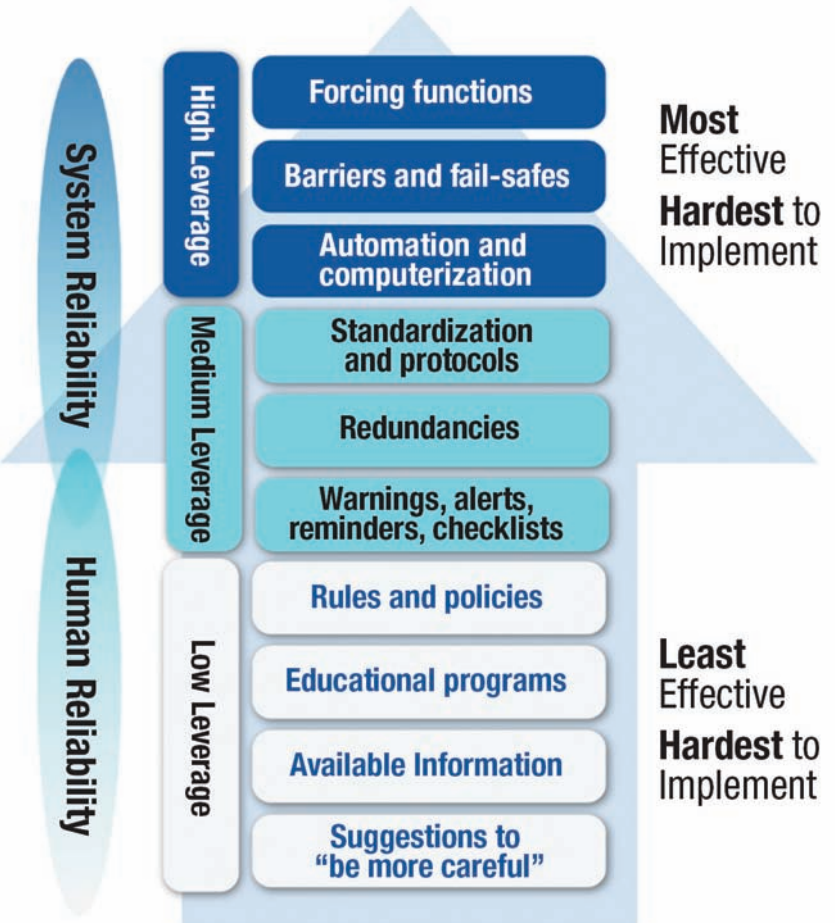
Anesthesia Quality Institute®
American Society of Anesthesiologists®

Anesthesia Incident Reporting System (AIRS)

Case 2022-10: We're Not Baking Cookies Here

A 14-year-old otherwise healthy female underwent a posterior spinal fusion for scoliosis. A TIVA anesthetic was used to accommodate neuromonitoring. Our organization uses a strict protocol for spinal fusions that specifies a single injection of intrathecal morphine prior to incision, infusions of ketamine and tranexamic acid, and I.V. access based on patient complexity and risk factors. The intraoperative course was unremarkable, except for a higher-than-usual infusion requirement of remifentanil. At the end of the case, the patient received the usual amount of hydromorphone, and the remifentanil was discontinued. The patient was extubated awake. On arrival to the PACU, the patient was severely agitated and reported 10/10 pain. The anesthesia team was very surprised at this. Repeated fentanyl doses were required to gain control of the patient's postoperative pain, and additional hydromorphone was given, as well as diazepam for potential muscle spasm. When the team returned to the OR, they noticed a spinal needle sitting on the anesthesia cart and reviewed the anesthetic record. They concluded that the intrathecal injection was never administered. Further review of the electronic anesthesia record showed no intrathecal dose of medication was documented.



For many years, the approach to an anesthetic was based on an individual anesthesiologist's collective experience. Where they trained, who their mentors were, or the "local color" of the anesthesia department guided the approach. I remember vividly asking an anesthesiologist as a trainee why they used a drug their partners eschewed, and the response was, "I do my case the way I do my case." The proverbial extra pinch of salt, or dexmedetomidine to smooth the flavor/wakeup, is de rigueur and highly regarded by many as the art of medicine. While many techniques are evidence-based, some are not and are baked in personal experience.

Through the advent of the Perioperative Surgical Home and an increased focus on quality improvement work, many cases now have anesthetic protocols designed to offer a consistent and reliable anesthetic that is aligned with the surgical management pathway for the patient. Perioperative pathways have reduced length of stay, infection rates, blood transfusion requirements, and a reduction in postoperative narcotics (*Anesth Analg* 2021;132:442-55; asamonitor.pub/3Jzck5R).

Dr. David Munch, an expert in process improvement, once noted that "you cannot see the abnormal until you've defined the normal." Assuming that your pathway or protocol defines the normal or the current best practice, when a pathway or protocol is not available or not used, it is difficult to see if you are providing best practice. If a "normal" is not defined, unnecessary variation and complexity can occur, and patients may arrive to the PACU in various levels of sedation or stages of emergence. A powerful aspect of an anesthesia protocol is that it can define a normal by which an abnormal result (e.g., pain) can be quickly identified and acted upon. This can allow the PACU or ICU team to detect potential issues much faster, as there is a consistent frame of reference to evaluate the patient.

In this case, the advantages and limitations of protocols become apparent. With process standardization, and other care team members relying on everyone completing all the upstream steps, there becomes an assumption that the patient received everything on the pathway unless it is noted in handoff. This case illustrates a relatively new failure mode, which is undetected deviation from an anesthesia protocol and how to prevent it.

The classic way we have approached anesthesia protocols has been via education, and at most we provide some sort of checklist as part of a reference document to guide adherence. The author recently performed a case in the IR suite that was tightly defined by a protocol, but the proceduralist wasn't aware of the steps, and it was difficult to find on the intranet. While defining protocols is ideally part of an overall perioperative pathway that can lead to a notable improvement in quality, this is predicated on the protocol being immediately available in the workflow of the anesthesiologist.

Over the past 13 years that the AIRS committee has been reviewing cases, systems issues are the most common issues reported in the database. A large subset of these errors is attributable to production pressure. Anesthesiologists are humans. While we are held to a standard above that, this sort of lapse is entirely normal behavior. What we endeavor to do is build strong systems that block normal human error from reaching the patient.

The Institute for Safe Medication Practices (ISMP) defines a hierarchy of effectiveness of steps to prevent errors and improve safety. While this is focused on medications, the parallels to anesthesia safety and quality are notable. A recent article highlights the salient point that "education is predictably disappointing and should never be relied upon alone to improve safety" (*BMJ Qual Saf* 2020;29:353-7; asamonitor.pub/3APQ8lz). If education and written documentation are insufficient, what are our options that improve reliability? The hierarchy of effectiveness defines which interventions are more likely to be effective; unfortunately, those that are more effective tend to be harder to implement.

In the chart, the interventions are divided into human reliability and system reliability. For the purposes of this discussion, we will ignore human reliability; however, it should be noted that the most common interventions are encompassed within this category. Education, a policy to follow the protocol, "available information" or posting the protocol in an accessible space, and when the protocol isn't followed, "remember to do the spinal next time" are low-leverage interventions that are unlikely to be effective.

Medium-leverage interventions, such as checklists and protocols, can be effective, but the checklist is only as valuable as its reliable use. Consider a checklist posted on the department intranet. The effectiveness of the checklist could be defined as the percentage of the time it is used when it is applicable. However, without a higher-level intervention, the user has to remember to access it and use it at every stage where it is applicable. This is a tall order for a static checklist on a webpage, as it is not integrated into the workflow of anesthesia care delivery.

System-based, high-leverage interventions address the issues above by integrating the information into the workflow of an anesthesiologist and providing forcing functions to alert the anesthesiologist that the task was not completed. The case description noted there was an EHR and anesthesia information management system in use for this case. Many of these platforms have the ability to present the protocol for the case in a series of events that allow for easy visualization of the protocol throughout the case.

Another possible level of automation is to deploy reminders that are keyed off of the lack of documentation for a specific event. For example, documentation of procedure start could trigger a review of documentation to that point and alert the anesthesiologist if an intrathecal dose or antibiotics did not occur. Even if it's too late at this stage to perform the block, the knowledge that the block was not performed could allow for injection by the surgeons later in the case or adjustment of the anesthesia plan to accommodate the error. Alternatively, if there is an

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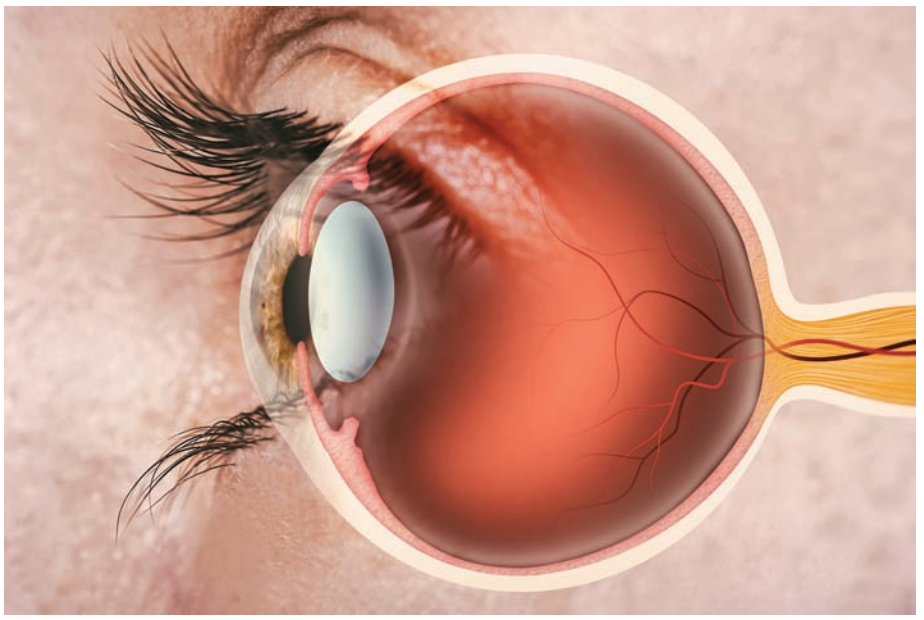
ACE Anesthesiology Continuing Education

ACE Question

Which of the following agents is MOST likely to decrease intraocular pressure?

☐ (A) Fentanyl ☐ (B) Succinylcholine ☐ (C) Midazolam



Ophthalmic surgeries are the most commonly performed surgical procedures in the United States. Intraocular pressure (IOP) is defined by the pressure exerted by different components of the globe to the containing wall. A normal IOP is 16 ± 5 mm Hg, and a value above 25 mm Hg is considered abnormal. A normal IOP is important for maintaining the normal integrity of orbital structures and proper refractory index. IOP is also important for maintaining ocular perfusion pressure, the difference between mean arterial pressure and intraocular pressure. Low ocular perfusion pressures (below 50 mm Hg) have been reported to cause irreversible injury to the retinal cells.

Anesthetic agents and the overall management of anesthesia have relevant effects on IOP (Table). Knowledge of these factors is important to avoid the undue rise of IOP during anesthesia, especially during ophthalmic surgery. Most of the anesthetic agents used for induction of anesthesia (e.g., propofol) have been shown to decrease IOP, as have all volatile anesthetic agents and short-acting opioids (e.g., fentanyl). Nitrous oxide, used in combination with sevoflurane and remifentanil, has not been shown to have any effect on IOP.

Table: Effects of Anesthetic Agents on IOP

Increases IOP	Decreases IOP	No Effect on IOP
• Succinylcholine (transient) • Neostigmine/ glycopyrrolate	• Propofol • Etomidate • Thiopental • Short-acting opioids (e.g., fentanyl, remifentanil, sufentanil) • Volatile anesthetic agents	• Ketamine • Midazolam • Rocuronium • Sugammadex

Midazolam has not been shown to affect IOP. Succinylcholine has been shown to transiently increase IOP. This effect is thought to be due to the contraction of extraocular muscles during fasciculation. Rocuronium does not have any significant effect on IOP. Reversal of neuromuscular blockade with neostigmine and glycopyrrolate significantly increases IOP. However, the use of sugammadex does not affect IOP. ■

References:

1. Kelly DJ, Farrell SM. Physiology and role of intraocular pressure in contemporary anesthesia. *Anesth Analg.* 2018;126(5):1551-1562. doi:10.1213/ANE.0000000000002544
2. Gropper MA, Cohen NH, Eriksson LI, et al, eds. *Miller's Anesthesia.* 9th ed. Elsevier; 2020:2197.

Answer: A

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anesthesia-ready event, an automatic review could be triggered at this stage and the block performed. These interventions, however, only work if the anesthesiologist is charting in near-real time. Engaging the entire perioperative team is another option to consider. Leveraging anesthesia and surgical timeouts, as well as the circulator's documentation, may allow for creating stronger interventions and allowing the whole team to be accountable to the protocol.

Anesthetic protocols, especially when coupled within perioperative pathways, can be highly effective at improving outcomes. But when steps are omitted and not recognized, this can be highly problematic as downstream providers may assume these steps were completed and not adequately consider the potential for human error. This case illustrates the need for highly reliable protocols while honoring the needs of the human condition.

Recommendations:

- Anesthesia protocols should be easily accessible at the point of care and their use agreed upon by the anesthesia department as well as the surgical service.
- The steps in the protocol should be integrated into the anesthesiologist's workflow and presented at the right time to be optimally effective.
- At key points of the case, a checkpoint should be completed reviewing the steps that should be performed by that point. The surgical timeout is a classic "checkpoint" that could trigger checklist review.
- When an AIMS system is in use, consult with your informatics group to assist in using electronic systems to automate these steps.
- Human error is ubiquitous in the practice of medicine. When designing a reliable workflow, always consider what would happen if the anesthesiologist "forgets" a step and block the error from reaching the patient via strong system design. ■

Each month, the AQI-AIRS Steering Committee abstracts a patient history submitted to AIRS and authors a discussion of the safety and human factors challenges involved. Absence of commentary should not be construed as agreement with the clinical decisions described. Reader feedback can be sent to **airs@asahq.org**. Report incidents or download the AIRS mobile app at **www.aqiairs.org.**