Learning From Others:

A Case Report From the Anesthesia Incident Reporting System

Case 2013-8: More Swiss Cheese Needed

Case 1: “After induction, BP cuff would not read, and pulses felt weak. I checked the \( O_2 \) sat and found that none was being recorded.”

Case 2: “[I] forgot to put ECG monitoring on patient before induction.”

Case 3: “Attending arrives while I.V. induction drugs are being pushed. Suction noise is audible coming from anesthesia machine but Yankauer not visible. [Provider] searches at all common locations … Finally realizes that the entire suction system is missing.”

A frequent theme of submissions to the Anesthesia Incident Reporting System is the recognition that an important anesthetic device or monitor is missing, usually immediately after a patient is induced, or when some critical event occurs. The reports above capture the sudden realization that if only a moment had been taken ahead of time to glance at the pulse oximeter, EKG, capnography, blood pressure or suction, the anesthesiologist’s motto of “Vigilance” would not have been violated.

The vast majority of anesthetics begin with the proper monitors and devices in place. In many cases in which necessary preparation is incomplete, no patient harm occurs. However, those cases in which poor preparation leads to preventable patient morbidity or mortality will haunt the provider forever. The most recent published data specific to anesthesiology finds that minor events or complications occur in 18-22 percent of cases, severe complications in 0.45-1.4 percent, and mortality at a rate of 1 in 100,000.² (The equivalent numbers from AQI’s National Anesthesia Clinical Outcomes Registry are 10 percent, 0.4 percent, and 3 in 10,000, based on somewhat different definitions.) What can a diligent but still human anesthesiologist do to improve these outcomes?

Humans are very good at creative and integrative thinking, but fallible when performing rote tasks that require consistency over time. Human systems that require high reliability – like flying a plane or anesthetizing a patient – must be built to address this important observation. The Swiss cheese analogy comes from the work of Reason, who noted that bad outcomes are not the simple result of a single error, but result from a system that allows the errors which inevitably occur to propagate all the way to a bad outcome.³ He imagined errors as arrows shot toward a target labeled “bad outcome.” In between the occurrence and the outcome he envisioned slices of Swiss cheese – the process itself – that would prevent the arrow from reaching the target. Each individual slice of cheese would have a hole or two that the arrow could enter, but with enough slices there would never be a straight path all the way through the cheese. To apply the example to the case reports above: anesthesiologists routinely look for a working suction just before pushing the induction medications. This is an important safety check (layer of cheese) that prevents adverse outcomes. Yet being human, once in a while the anesthesiologist will get distracted and forget to make this observation (the hole in the cheese). Most of the time this won’t matter, because the suction isn’t actually needed (another slice). Most of the time aspiration won’t matter (another). Most of the time aspiration pneumonia resolves without incident (yet another). Yet sometimes the holes line up, and an error propagates to an injury. Failure to check the suction leads to two weeks in the ICU with aspiration pneumonitis.

Checklists are a popular method to bridge the gap between “most of the time” and “all of the time,” especially in process-oriented industries such as aviation, manufacturing and software development. Within medicine, the 2006 study by Pronovost et al. demonstrated that using a checklist significantly reduced central line-associated bloodstream infections.⁴ In perioperative medicine, the 2009 study by
the Safe Surgery Saves Lives Study Group showed that using a World Health Organization checklist – modified for local conditions – significantly reduced both morbidity and mortality. The checklist was found to be useful in both tertiary care facilities in the United States and Europe and in resource-challenged hospitals in the developing world. This study is significant because it provided statistical evidence that a perioperative checklist could improve outcomes even in high-income countries.

Several items on the WHO checklist relate to anesthesia practice: the most obvious is confirmation that pulse oximetry is being used. Another item is the combined “sign in” with the surgeon and nurse to ensure all parties that the correct operation is being done on the correct patient. A final element is “completion of an anesthesia safety check.” Specialty-specific anesthesiology checklists have traditionally focused on identifying faults with the anesthesia machine. The most recent ASA checklist guideline, published in 2008, provides a template of 15 items to be completed at the start of every O.R. day, and a subset of eight items to be repeated prior to every anesthetic.

What are the commonly missed items in the preanesthetic setup? A study published in 2011 by DeMaria found that the most commonly missed steps were a working suction setup and a self-inflating manual resuscitation device (Table 1). Missed steps were more common in rooms where a regional anesthetic was planned, and in rooms with over five cases scheduled. In a 2010 study by Thomassen in Norway that piloted a novel anesthesia checklist, the most commonly missed items were the second laryngoscope, presence of an introducer in the endotracheal tube, testing the cuff on the endotracheal tube and the presence of the self-inflating resuscitation bag.

### Table 1: Most Commonly Missed Pre-Anesthetic Steps

(from DeMaria Table 3)

<table>
<thead>
<tr>
<th>Step</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-inflating manual resuscitation bag</td>
</tr>
<tr>
<td>Machine check</td>
</tr>
<tr>
<td>Working suction set-up</td>
</tr>
<tr>
<td>Airway emergency devices</td>
</tr>
<tr>
<td>Emergency drugs</td>
</tr>
</tbody>
</table>

This year, the Anesthesia Patient Safety Foundation (APSF) is spearheading an effort to build and validate a streamlined pre-induction checklist for anesthesiologists. The Pre-Anesthetic Induction Patient Safety (PIPS) Checklist, or PIPS, is presented in Table 2. The checklist items include many of the missed items discussed above, including verification of suction and monitors. APSF is seeking academic partners to pilot the use of this checklist and report on the outcomes achieved; more information can be found in their summer newsletter, available now at [www.apsf.org](http://www.apsf.org).

No checklist can be effective without a culture that supports its use. A review of surgical checklist studies found that effective implementation depends on surgical team compliance and that compliance increased if team members

### Table 2: Anesthesia Patient Safety Foundation Pre-Anesthetic Induction Patient Safety (PIPS) Checklist

<table>
<thead>
<tr>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suction is working</td>
</tr>
<tr>
<td>Anesthesia workstation can provide ventilation with 100% oxygen under positive pressure</td>
</tr>
<tr>
<td>Upper-airway status has been evaluated</td>
</tr>
<tr>
<td>Backup airway devices are immediately available</td>
</tr>
<tr>
<td>Patient’s significant drug allergies and possible drug interactions noted</td>
</tr>
<tr>
<td>NPO status and aspiration risk confirmed</td>
</tr>
<tr>
<td>Monitors are functioning with appropriate waveforms</td>
</tr>
<tr>
<td>Audible and visual alarms are set appropriately</td>
</tr>
<tr>
<td>Appropriate medications, including resuscitation drugs, are available</td>
</tr>
<tr>
<td>Intravenous access (if indicated) is appropriate and functioning</td>
</tr>
</tbody>
</table>
| Special considerations for this patient confirmed (may include but not limited to):  
  • Increased risk for operating room fire  
  • Surgical positioning requirements  
  • Goals for blood pressure and/or heart rate management |

Continued on page 50
were involved in the development of the checklist. This review suggested that checklists must be integrated into the hospital’s workflow, and the items must be those that team members view as real safety risks. For example, in a hospital where intravenous lines are always started in the O.R. by the anesthesiologist, having “functioning I.V.” on the pre-induction checklist may be less useful than in an ambulatory surgical center where the I.V. is placed in the preoperative holding area. A pulse oximetry item might be more useful in a developing-world O.R. than in a tertiary care hospital.

A checklist used only some of the time is unlikely to improve patient outcome. Sustained use of a checklist can only be achieved with aggressive training of the entire perioperative team, an awareness campaign, and some local combination of carrots and sticks. Team effectiveness training, such as with the AHRQ/DoD TeamSTEPPS program, can make it easier for an anesthesiologist to ask for the room to hold while the checklist is being completed. Checklist awareness can be improved with O.R. posters, computer screensavers and reminders placed within sterile packs. Monetary incentives can be provided for anesthesiologists that reach 100 percent compliance with checklist documentation, or penalties imposed on those who do not comply. Top-down approaches like this can help get a checklist started, but real buy-in occurs when individuals first experience the avoidance of a preventable error. This effect can be seen in the testimonial of a surgeon who could have avoided a wrong-side surgery if a pre-surgical checklist had been employed.

Because we are human, we will always make errors. Because we care about patient safety, we can and will build systems of “Swiss cheese” that help us catch and correct our errors before they cause adverse outcomes. All of us remember, and would just as soon not repeat, that sudden sinking sensation when we reach for the suction that isn’t there.

References:

“This is an important safety check (layer of cheese) that prevents adverse outcomes. Yet being human, once in a while the anesthesiologist will get distracted and forget to make this observation (the hole in the cheese).”