How to improve patient safety in the operating room anesthesia work area
Chairman: Professor Xavier Capdevila

Medication Errors in the OR: Causes and Epidemiology
Dr. Sven Staender

Medication Safety: Insights from an Expert Pharmacist
Dr. Edith Dufay

Strategies to Prevent Medication Errors
Professor Joyce Wahr

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At the 2019 Euroanaesthesia Congress in Vienna, Austria, Professor Xavier Capdevila chaired a symposium supported by Aspen with Dr. Sven Staender, Dr. Edith Dufay, and Professor Joyce Wahr. The discussion focused on the types of medication errors that occur in the operating room (OR) and specific strategies to improve patient safety. These strategies include facilitating closer cooperation between physicians and pharmacists, fostering a culture of teamwork in the OR, and implementing technologies and process changes designed to prevent or reduce medication errors.

**THE IMPORTANCE OF PATIENT SAFETY – PROFESSOR XAVIER CAPDEVILA**

*Chairman:*

Professor Xavier Capdevila, MD, PhD, head of the Department of Anesthesiology and Critical Care at Montpellier University Hospital in Montpellier, France, and current president of the French Society of Anesthesia and Critical Care (SFAR).

Professor Xavier Capdevila introduced the session by explaining that patient safety is probably the most important topic for anesthesiologists and intensivists. And the risk of medication errors in the OR is not often discussed. Approximately 13–14 million patients are harmed each year as a result of medication errors, at a cost of billions of dollars. Understanding the root causes of medication errors in the OR and building a safety culture in which medication errors are reported and analyzed are the first steps toward implementing solutions to prevent medication errors and ensure greater patient safety.
Dose calculation and medication labeling

Another point of medication error is at the time of drug calculation. Calculations are often required when a medication must be reconstituted to reach a specific dilution; in many cases, this process can be complex. Dilution errors are seen more often in pediatric patients, where a “factor-10 error” in medication dosing has been noted across various medications. Errors in dose calculations can happen because of a medication’s labeling, which can be difficult to read, particularly when prepared medications are hand-labeled with the name and the concentration. In addition, incorrect label placement over the medication name and dose on prepared syringes or bags can make it challenging to verify dosing. Likewise, unlabeled containers of liquid in the surgical field can lead to misidentification of medications and increase the risk of errors that affect patient safety.

Medication contamination: the case of propofol

Medication errors can also be introduced at the point of medication administration. In addition to errors in dosing, administration site selection, and improper flushing, patient safety during medication preparation can be compromised by poor hygienic practice. The importance of hygiene was illustrated in a study of propofol, which is provided in a nutrient-rich emulsion that is easily contaminated and facilitates the growth of microorganisms. In that study, concentrations of various bacterial contaminants increased within a 3-way stopcock system 48 hours after propofol administration, even when there was no visible propofol in the line after flushing (Figure 2). The study results suggested that flushing is not sufficient to prevent contamination, and that it is not safe to assume the risk is decreased when there is no visible propofol in the line. Strict hygienic practices are recommended when manipulating propofol, including using two three-way stopcocks with the proximal stopcock used for delivery, so that the distal stopcock and line can be disconnected and the proximal (with “contaminated” propofol) stopcock discarded after the procedure.

Epidemiology of drug errors

Although medication errors are a significant problem in the OR, Dr. Staender explained that only a few robust studies have evaluated medication error incidence and prevalence. Data from the United States Pharmacopeia (USP) in 2003 indicate that prescribing errors and improper dosing were the most common types of medication errors. Yet the impact of these errors varies: an analysis of data from USP MEDMARX, a voluntary, anonymous reporting system, found that 82.7% of medication errors do not actually reach the patient or cause harm (e.g., error, no harm). Several studies have analyzed the incidence of anesthetic administration errors using data from reporting systems. The results show incidences ranging from 1 in 133 patients to 1 in 450 patients. However, the data from reporting systems should be interpreted with caution because of the bias introduced by voluntary reporting. Indeed, observational studies have revealed very different medication error incidences. Merry et al reported a drug administration error rate of between 1 in 9 and 1 in 11 administrations. A more recent study by Nanji et al reported a medication error and/or adverse drug event rate of 1 per 20 perioperative medication administrations.
The impact of medication shortages

Various factors contribute to medication errors, from disorganized or stressful workplace conditions to a lack of communication and coordination of the OR team. Workplace pressures are compounded by a trend toward higher procedural volumes and a rise in medication shortages. In a survey conducted in 38 countries by the European Association of Hospital Pharmacists, approximately 35% of respondents reported daily medicine shortages and 38% reported weekly shortages. Shortages of anesthetic agents in particular have increased from approximately 30% in 2014 to over 40% in 2018. Medication shortages most often lead to substitution with equivalent drugs and drug rationing, both of which increase the risk of errors. Medication shortages also increase costs for hospitals and pharmacies, because the substituted medications are often more expensive. A Canadian study reported that shortages of anesthetic agents most often lead to modifications of anesthetic techniques, administration of less familiar drugs, and postponement or cancellation of procedures.

Anesthesiology is the safety discipline in health care.” – Dr. Sven Staender

Dr. Staender concluded that anesthesiologists are critical advocates for patient safety; they need to speak up when processes are dangerous and encourage teams and organizations to reconsider workflows and discuss approaches to minimize medication errors and maximize patient safety. By working together with pharmacists, administrators, and companies, anesthesiologists can help find solutions that will limit the risk of medication errors.

References

MEDICATION SAFETY: INSIGHTS FROM AN EXPERT PHARMACIST – Dr. EDITH DUFAY

Speaker:
Dr. Edith Dufay, PharmD, Head of pharmacy at the Centre Hospital of Lunéville in Lunéville, France

Dr Dufay discussed the importance of opening a dialogue between anesthesiology and the pharmacy. Because practical solutions need to be developed to recognize, report and prevent medication error in the OR. The ultimate goal is to optimize patient safety. The reduction and prevention of medication errors relies on a holistic, global approach to patient care, in which specialists cross disciplinary lines to work as a team in the OR. The delivery of patient-centered care can be interrupted at several points along the patient’s journey—at admission, transfer, and discharge—and communication and information sharing between the OR team and the pharmacist is critical at each of these points to reduce medication errors.

REMED, a project to review and prevent the occurrence of medication errors

Dr. Dufay presented the Review of Errors in Medication project, called REMED, in which pharmacists convene a meeting of all healthcare providers involved in a medication error to engage in a collective, retrospective, blame-free, in-depth analysis of the error. By design, medication errors are considered to be unintentional, such that the healthcare providers involved are not only secondary victims of the error but also a valuable source of information that can be used to improve the medication system to avoid future errors. During the REMED meeting, a methodology with 11 tools is used to fully analyze the error, its causes, associated risk, and potential solutions. One of these tools is a comprehensive characterization of the medication error based on six features (Table 1).
An important benefit of the REMED medication error characterization methodology is that it brings together the team of healthcare providers, each with their own perspectives, and encourages them to discuss the error objectively. Specialists must communicate across disciplines to find a common language and reach a consensus. For example, the REMED characterization method was used to analyze a medication error that occurred during a peridural analgesia procedure on a pregnant woman. The team identified multiple factors that led to the error, which occurred at multiple levels—from confusion caused by look-alike medications to a lack of established protocols for a specific procedure in the OR. Once the six features of the medication error were agreed upon, the team was able to identify the root causes and develop specific improvement actions.

At Dr. Dufay’s institution (Lunéville Hospital Center), the REMED has been positioned as a process across disciplines to find a common language and reach a consensus. For example, the REMED characterization method was used to analyze a medication error that occurred during a peridural analgesia procedure on a pregnant woman. The team identified multiple factors that led to the error, which occurred at multiple levels—from confusion caused by look-alike medications to a lack of established protocols for a specific procedure in the OR. Once the six features of the medication error were agreed upon, the team was able to identify the root causes and develop specific improvement actions.

Medication reconciliation
While medication reconciliation is one of the most powerful methods to intercept and prevent medication errors, it continues to be a challenging task for many organizations. Medication reconciliation takes into account, at the time of a new prescription, all the medications that a patient is taking and has been prescribed. Implementation of medication reconciliation requires coordination of information sharing between multiple care providers and the patient at the transition points of admission, transfer, and discharge.

A recent study, initiated as part of the World Health Organization’s High 5 Initiative to implement medication reconciliation in 5 countries, collected data on medication errors intercepted by the pharmacist through medication reconciliation for patients 65 years of age or older at the time of admission to the emergency department. The potential severity of the consequences had the prescription been given to the patient were also assessed. Of 1677 medication errors intercepted and corrected, most (69.1%) were minor, but 18.8% were significant and 5.2% were major or catastrophic.

To reduce medication errors for patients admitted through the emergency department, healthcare providers are encouraged to report the medication history in the electronic medical record (EMR) so that it can be communicated to the pharmacist and used for medication reconciliation and to set up prescription orders. For patients with a planned surgical intervention, providers can work with community pharmacists to receive a medication history prior to hospitalization and discuss any potential medication errors.

Pharmacists in the OR
Assigning pharmacists to the OR can facilitate communication between the pharmacist and anesthesiologist so that they can more quickly discuss and address medication errors. As a member of a multi-professional team within the OR, the pharmacist would order medications directly from the OR rather than through the pharmacy, and work closely with the anesthesiologist to prevent drug errors, ensuring the right medication is given to the right patient for the right intervention. In the OR, one of the most common consequences of drug errors is a delay of the intervention. Assigning pharmacists to the OR can reduce delays in surgical interventions, with a significant cost savings and sustainability (Figure 3).

Dr. Dufay closed by re-iterating that cross-disciplinary cooperation and communication are significant challenges in preventing medication errors. Anesthesiologists are encouraged to seek out opportunities to change processes to improve patient safety, and to include the pharmacist in those efforts.

Table 1. Six Features of Medication Errors Analyzed in the REMED Meeting

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
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<tbody>
<tr>
<td>1</td>
<td>Healthcare product involved</td>
</tr>
<tr>
<td>2</td>
<td>Type of error</td>
</tr>
<tr>
<td>3</td>
<td>Stage at which the error was detected and intercepted</td>
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<tr>
<td>4</td>
<td>Seriousness of the error</td>
</tr>
<tr>
<td>5</td>
<td>Potential risk of the medication error if it had not been intercepted</td>
</tr>
<tr>
<td>6</td>
<td>Stage at which the medication error was identified</td>
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</tbody>
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This is extracted from Dr Dufay’s slide.
Figure 3. This is a slide from Dr Dufay. Improvements in workflow with inclusion of pharmacists or pharmacy technicians in the OR team. Image published with permission of Dr. Edith Dufay.

References

STRATEGIES TO PREVENT MEDICATION ERRORS – PROFESSOR JOYCE WAHR

Speaker:
Professor Joyce Wahr, MD, Department of Anesthesiology at the University of Minnesota of Minneapolis in Minnesota, United States

Professor Wahr described that while medication errors are top of mind for anesthesiologists, the recommendations available in the literature to prevent medication errors are based primarily on expert’s opinion.

Also only two randomized controlled trials, published by Merry et al., have tested a system of medication delivery (SAFERSleep™) for reducing medication errors in the OR. The system includes a customized medication tray and medication cart drawers designed to promote a well-organized workspace and aseptic technique. And the system also recommends to use:

- Pre-filled syringes for commonly used anesthetic medications
- Large, legible color-coded drug labels
- A barcode reader linked to a computer, speakers, and touch screen to provide automatic auditory and visual medication verification

The results of these trials, presented by Professor Wahr, showed that in 1075 cases, the overall mean rate of drug errors was 9.1% with the new system (1 in 11 medication administrations) and 11.6% with conventional methods (1 in 9 medication administrations) (P = 0.045). The study was repeated in 80 simulated cases in which “error traps” were introduced (e.g., purposefully putting the wrong vials in the medication trays) to test the system’s ability to intercept the errors. The mean rates of error were 6.0% for the new system vs. 11.6% for conventional methods (P = 0.001).

Beyond these two trials, recommendations for reducing medication errors are based on systematic reviews and consensus documents. In 2004, Dr. Jensen and colleagues reviewed 98 studies on medication errors and assigned points based on the quality of the study. This review led to 1 general and 5 specific recommendations, which focused primarily on labeling, organization, and using a two-person check. In 2010, the Anesthesia Patient Safety Foundation released a set of consensus recommendations based on input from approximately 100 professionals. Recommendations fell into 4 major categories (Figure 4):

- Standardization
- Technology
- Pharmacy/prefilled/premixed
- Culture

Review of strategies to improve patient safety
In 2013, Professor Wahr revisited Dr. Jensen’s approach by conducting a systematic review of studies on medication error and medication safety, specifically focused on anesthesia medications in the cardiac OR. The review included 186 articles, of which 111 were excluded (single-author case studies), and points were awarded for the strength of the study. The review also included currently available recommendations (from the Institute for Safe Medication Practices in Canada, the Anesthesia Patient Safety Foundation, and the Institute for Healthcare Improvement) and guidelines from the Centers for Disease Control, Association of Peri-Operative Registered Nurses, and the American Society of Healthcare Pharmacists. For each recommendation, the number of times the recommendation was made and the total number of points given to the studies in which those recommendations were made were reported. Compared to the recommendations compiled in 2004, Dr. Wahr and colleagues found a greater emphasis on recommendations related to improving the culture and working environment within the OR, followed by recommendations regarding labeling. A modified Delphi analysis generated a list of the top recommendations for reducing anesthesia medication errors in the cardiac OR (Table 2).

The recommendations echo many of the same themes noted by Drs. Staender and Dufay in their lectures, such as the importance of fostering a culture of safety in the OR so that the anesthesiologist feels comfortable reporting errors, and the critical role of the pharmacist. In the area of medication administration, recurring themes also included medications “prefilled, compounded, and diluted by pharmacy” and implementing a two-person check.

While many of the recommendations regarding cart organization have already been put into practice, such as using single-use vials and removing high-risk medications, other recommendations that could be implemented easily include color-coded labeling of every syringe and container and labeling of all routes of administration (IV, arterial, neuraxial), especially those with a stopcock in the line.
Building a culture of safety

“Unlike other areas of the hospital, anesthesiologists are the only ones who prescribe, dispense (take it out of the drawer), prepare (put it in a syringe), and administer medications without a check.” – Professor Wahr

While anesthesiologists work within a team in the OR, in the area of anesthetic medications, teamwork is not emphasized. Assigning a pharmacist to the OR is one approach to improving medication safety, and anesthesiologists are also encouraged to “develop a questioning attitude” and to speak up if something does not make sense.

In the OR, the anesthesiologist works with both anesthesia medications and machines, but many more advances have been made on the machine side to ensure patient safety. In addition, the safety measures on these machines are built-in and hard to override; anesthesiologists have no choice of whether to implement these measures or not. Conversely, there is almost nothing forcing anesthesiologists to follow best practice recommendations for medication safety. It requires a conscious choice and effort. Bar code scanning is likely the best technological advance, other than prefilled syringes, on the medication side to improve patient safety, yet very few institutions have implemented bar code systems in the OR.

Other advances on the medication side include networked surveillance, which strengthens the connections between the anesthesiologist in the OR, the pharmacist, and the EMR to introduce more safety checks into the flow of anesthesia medications.

To prevent wrong route administration, the International Standards Organization developed ISO80369 in 2008 to mandate the design of small bore connectors unique to each administration route.
Finally, Professor Wahr concluded by a new thinking about safety. For much of the last 20 years, we have been focused on what goes wrong. This approach is necessary and cannot ever go away. But it is also necessary to focus on what goes right in order to inform, prevent wrong actions and therefore get safer.

**References**

SYMPOSIUM CONCLUSION
Anesthesiologists are the patient safety advocates in the OR, and are positioned to recognize processes and factors that increase the risk of medication errors and take the initiative to implement changes at their institutions to reduce that risk. Technological advances, such as bar code systems, can prevent errors despite human factors but at a high cost, whereas other interventions—cart organization, assigning a pharmacist to the OR, or fostering a culture of teamwork in the OR—may cost less but require a change in practice and conscious effort by the OR team. Anesthesiologists could also engage manufacturers to find new solutions to reduce medication errors and improve patient safety.