Why do Anesthesiologists Drug Administration Errors?

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Abstract

Medication error represents a particular challenge for the patient safety in tertiary care. Anesthesiologists should attempt against errors because they represents the unique medical specialty that administrate the drug without another professional conference, easily acting as vectors of adverse events during anesthesia [1]. Some factors expose more than others the susceptibility to undesirable events. This review has the purpose to define the main characteristics of drug administration errors in anesthesia practice. Mesh terms “medication errors”, “anesthesia” and “anesthesiologists” were combined during the search for studies used in this review. Anesthesiologists errs during the whole perioperative period, but most cases tend to happen in the morning, at the beginning of anesthesia, with no harm, by in-training providers in all types of surgeries and patients. Errors as incorrect dose and substitution due to distraction and fatigue are more common. Some routines should be incorporated to the experience of the anesthesiologist to facilitate the correct practice.

Purpose

Medication error represents a particular challenge for the patient safety in tertiary care. The overall rate is observed in order of 4.87 errors per 100.000 administrations by pharmacists [2]. Anesthesiologists should attempt against errors because they represents the unique medical specialty that administrate the drug without another professional conference, easily acting as vectors of adverse events during anesthesia [1].

Drug administration demands whole attention in the perioperative period, but not always respected in anesthesia practice. In a recent study, adverse events occurs in 1 of 3 anesthetics, medication error in 1 of 2 anesthetics and one of them in 1 of 20 perioperative medication administration [3]. One estimation shows that each anesthesiologist errs seven times a year and causes damage to patients twice over a career [4], representing high and unacceptably common situations.

Medication error is defined as a failure to execute an action in the drug administration process or the use of an incorrect plan or action to achieve a patient care aim [5] and an adverse drug

event as patient harm or injury due to administration of a drug [6]. The steps of the administration process include requesting medication from pharmacy, dispensing the medication from the pharmacist to the anesthesiologist, preparing the medication (e.g., aspiration, dilution), administering the drug to reach the patient, documenting in the anesthesia information management system and monitoring the vital signs or patient exams after the administration [3]. According to the working system, errors can be divided in active failure, caused by people in direct contact to the patient, and latent condition, due to the system. Also, errors can be classified as due to omission (failure to perform an appropriate action) and commission (perform an inappropriate action) [7].

At most cases, medication errors occurs at administration stage (53%), followed by prescription (17%), preparation (14%) and transcription (11%) [8]. Some factors expose more than others the susceptibility to undesirable events. Leading the causes in anesthesia, medication errors far exceeds disconnection of the breathing circuit, the second cause of adverse events [9]. This review has the purpose to define the main characteristics of drug administration errors in anesthesia practice.

Mesh terms “medication errors”, “anesthesia” and “anesthesiologists” were combined during the search for studies used in this review. Related studies to them were also used.

Type of Errors

Errors like syringe swaps, drug ampoule swaps, overdose or incorrect drug choices were cited [10,11], but were also found more detailed as incorrect route (administration of a drug by another route), incorrect dose (unwanted concentration, amount or infusion rate), insertion (drug administered in unwanted time), replacement (administration of a drug different from the indented one), repetition (readministration of a drug due to prior administration uncertainty) and omission (a forgotten/non-administered drug) [1].

Different results were observed in the studies. In Orser, et al. [10] self-reports study; the commonest cited errors were syringe

swaps (70.4%) and misidentification of the label (46.8%). Yamamoto, et al. [11] retrospectively analyzed an amount of (27454) anesthesia cases during previous 8 years, with only 61 administration errors, mainly overdose (25%), followed by substitution (23%) and omission (21%), also observed in another large prospective observational study, as incorrect dose (36.5%), substitution (25%) and omission (19.2%) [9]. Recent prospective study realized during 277 operations observed higher prevalence of labeling error (24.2%), followed by dose error (22.9%) and omission (17.6%) [3] that corroborates another recent study about one Brazilian State anesthesiologist's errors [1].

Contributing factors to errors

Distraction/fatigue was the commonest leading factor to errors, followed by misread label, pressure to proceed and improper storage, respectively. Other evaluated items were lack of knowledge or experience, unfamiliar vial or ampoule, inadequate communication among anesthesiologists, equipment malfunction, equipment not available and others [1,12]. Cooper, et al. [13] cited factors with similar terms, but at most cases related to inadequate total experience.

Despite Orser, et al. [10] describes 94.9% of respondents anesthesiologists reports most of the time or always read the label, when asked about the single most important feature of the label, 50.7% identify colors, 26.9% identify more than 1 feature on the label, 7.5% drug name, 7.1% shape of container, 3.4% size of container and below 1% syringe codes, acting as contributing factors.

Time of errors

For the period of day that error cases occurred, Erdmann, et al. [1] described higher incidence in the morning (32.7%), in the afternoon (21.8%) and lower in the evening (16.3%). Fasting, et al. [14] observed that 56 of 63 drug errors occurred in day shifts. No other related data were found in the reviewed studies.

Perioperative period of errors

A unique study described the most frequent anesthesia period of error. Errors were most reported by anesthesia providers during maintenance of anesthesia (49%; 42%), followed by induction of anesthesia (30.9%; 28%) [1,14], extubation (12.7%), pre anesthetic (5.5%) and post anesthetic periods (1.8%) [1]. Nanji et al. (2016) found that 53.9% of events (including medication error and adverse drug event) occurred within 20 minutes of induction period [3].

Drug Involved

Observational studies observed higher incidence of medication errors in administration of sedatives (propofol) and opioids (fentanyl) were related to 47.4% of incorrect dose errors [3,12]; steroids (dexamethasone) and vasoactive medications were related to 46.2% of substitution errors [12]. On the other hand, Yamamoto, et al. [11] observed antibiotics as the most frequently involved agents (23%), followed by muscle relaxants (15%) and vasopressors (15%) in overall drug administration errors during anesthesia.

Surgery type

If considered the surgery type, different results were observed. Vascular surgeries are on top 2 most common risk of medication errors (6.8%; 1.32%), following general surgery (7.7%) [3] or pediatrics (1.69%) [12] in different studies. Thoracic (5.9%; 1.00%), orthopedic (5.5%; 0.56%) and other abdominal surgeries are also relevant, but without statistically significant association [3,12].

Anesthesia type

Nanji, et al. [3] observed 5.5% events (including adverse events) in general anesthesia versus 4.6% in sedations, without significant difference between event rates ($p = 0.52$). Under neuraxial anesthesia, 7% of respondents reported drug administration error by this route [1].

ASA classification: Cooper et al. (2012) analyzed the relative risk reported in cases of medication error/pre-error of 8777 anesthesia involving ASA III (0.81%) compared with ASA I (0.28%) and ASA II (0.43%) patients, with statistically significant difference under ASA III and ASA I patients ($p = 0.001$) [12].

In a recent study, Nanji, et al. [3] described 2.9% of medication errors in ASA I physical status score patients, 4.1% in ASA II, 4.7% in ASA III and 7.1% in ASA IV patients, with no statistically significant association ($p = 0.56$).

Body mass index, duration of procedure and medication administrations: No significant association existed when compared Body Mass Index (BMI), defined as normal, overweight and obese, with medication errors [3].

Procedures duration analyzed as less than 1h (3.0% of medication errors), 1-3h (4.2%), 3-6h (4.1%) and more than 6h (7.3%) reveal that longer procedures, especially greater than 6 hours, had higher medication error rates ($p < 0.0001$) than shorter procedures [3].

Despite 13 or more medication administrations had significant difference of adverse drug events rates between 12 or fewer (1.8%) and 13 or more (2.8%) ($p = 0.002$), no significant association was observed between 12 or fewer (4.8%) and 13 or more (3.9%) ($p = 0.11$) [3].

No other related data to BMI, duration of procedure and number of medication administrations were found in the reviewed studies.

Experience of provider

In a study with anesthesia providers (in-training and experienced, nurses and physicians), statistically significant difference was observed between comparison of provider-in-training group (0.74% or 1:135 anesthetics) and experienced provider group (0.37% or 1:272 anesthetics) with a relative risk of 2 ($p = 0.0087$) for the distribution of reported medication errors/pre-errors [12]. Considering overall events (medication errors and adverse events), no significant difference existed between house staffs (5.1% event rate), nurse anesthetists (5.5%) and attending anesthesiologists (4.5%) ($p = 0.79$) [3].

Injury severity

Negative outcomes were stratified in different types in the reviewed studies. Most cases of medication error caused no harm or minor consequence. Major consequence with reversible or irreversible damage (including cardiac arrest, stroke and permanent injury) was reported by no more than 8.75% of medication errors [1,3,10-12,14].

No fatal errors were described in most studies [1,3,11,12]. Only one study reported a number higher than 0.4% of deaths, but included all type of anesthesia/equipment errors [9]. Orser, et al. [10] reported 4 fatal medication errors (<0.4%) resulted from overdose of ketamine due to misidentification of a vial, administration of norepinephrine instead of fentanyl, potassium chloride solution used to dilute an antibiotic and peritoneal dialysate infused in another route.

Medication Shortage and Safety in Anesthesia

Shortage of perioperative drugs are inversely related to patient care. The anesthesiologist should caution on lack or return of medications, as a newer concentration or changing the anesthesia technique, in adaptation to avoid administration errors [15].

As reported by Ogboli-Nwasor, [16] similar ampoules induce drug administration errors, when in different medications and different doses. To avoid these cases and for safety in anesthesia, system contributing factors are already used, as color- and barcode [16-19], and a double-check by one person or “four-eye-check” by two qualified practitioners [20], when possible. Other safety system is syringe, needle or other devices connectors that connect with a specific kind of route injectors [20].

Jensen et al. [21] summarized potential strategies to prevent drug administration errors during anesthesia as:

- Read the label of medication ampoule or syringe before the medication drawn up or injection
- Syringes need to be labeled
- Organize the position of ampoules and syringes, and caution with dangerous medications on anesthesia workstation
- Double-check medications before administration
- Report any drug administration error during anesthesia
- Appoint a dedicated pharmacist for the operating room
- Avoid the use of similar ampoules and syringes of medications
- Use prefilled syringes for medications, if possible
- Only the anesthesia provider who will administer the medication should drawn up and label the medication
- Standard color code by class of medication should be agreed

Tobias, et al. [22] mentioned the “5 rights of medication administration” to follow, as:

- The right patient
- The right drug
- The right dose
- The right time
- The right route

Nowadays, despite the different workplaces, these factors are seen on anesthesia practice in most countries and must be worldwide introduced.

Conclusions

Anesthesiologists errs during the whole perioperative period, but most cases tend to happen in the morning, at the beginning of anesthesia, with no harm, by in-training providers in all types of surgeries and patients. Errors as incorrect dose and substitution due to distraction and fatigue are more common. Some routines should be incorporated to the experience of the anesthesiologist to facilitate the correct practice.

Declarations

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Disclaimer

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