

EDITORIAL VIEW

Medication errors: A matter of serious concern

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ABSTRACT

The incidence of medication errors is increasing and the exact incidence is likely greatly underestimated and under-reported. Although the majority of these errors occur due to lack of knowledge of or failure to follow accepted protocols, look alike medication containers are the primary cause in many cases of drug error related morbidity or even mortality. With the number of drugs and the number of pharmaceutical companies manufacturing the same drug on an increase, the incidence is likely to increase. It is a universal problem that can be found in any operating room throughout the world, as demonstrated by the multi-national representation of many reports on this subject in the literature. This editorial supplements a case report, the 'Clinipics®' page and a special article on the topic of hazards of look-alike drug containers published in this issue of *Anaesthesia, Pain & Intensive Care*. The authors also attempt to present strategies to reduce these medication errors. The development of a non-blame environment where errors are openly reported and discussed and regulations for labeling the drug containers, vials and ampoules is stressed.

Key words: Medication errors; Medication Errors/prevention & control; Morbidity; Mortality; Drug containers; Root cause analysis

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INTRODUCTION

Medication errors remain a leading cause of morbidity and mortality in hospitalized patients. These concerns are magnified during the perioperative period and in the operating room given the frequent use of numerous medications, the rapidity with which medications are prepared and administered as well as the general pace of this clinical environment. From a cursory review of the literature, it readily becomes apparent that the incidence of such problems is increasing and the incidence is likely greatly underestimated and under-reported. Furthermore, these problems have plagued anesthesia providers since the advent of our specialty with publications regarding such problems first appearing in the 1950's.¹ The literature is replete with case reports and surveys documenting these events involving numerous different medications. The Quality in Australian Health Care Study reported a 16.6% incidence of adverse events in 14,000 admissions.² A medication error was the 4th most common adverse event resulting in permanent

disability in 17% and death in 8% of the cases. The authors also noted that they considered 51% of the events to be preventable. As demonstrated by the multi-national representation of these reports, this is a universal problem that can be found in any operating room throughout the world.³⁻¹⁰ An analysis of 'critical incidents' indicates mis-identification of syringes and drug ampoules as the most common cause of preventable mishaps.¹¹ In some cases, this is simply the result of printing on these vials being too small or poorly labeled.

Further review of these data with a focus on anesthesia providers, clearly demonstrates that we are not immune from such problems. A survey of 66 anesthesia providers in New Zealand reported that during their careers 89% believed that they had committed at least 1 medication error with 12.5% attributing some patient harm to the mistake.¹² In a prospective study in which anesthesia providers were asked to voluntarily report whether a medication error had occurred during their anesthetic care, the incidence of

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such problems was 1 per 133 cases.³ Taken together, these studies have demonstrated an incidence of medication error during anesthetic care of approximately 1 in every 100 to 400 anesthetics.¹³ Common mistakes have included the incorrect dose, wrong medication, failure to administer the medication, repetition of a dose, and the incorrect route. The types of medications most commonly involved have included neuromuscular blocking agents, antibiotics, opioids, sedatives, vasoactive medications, inhalational anesthetic agents, and local anesthetic agents. These data are important as we must realize that medication errors include not only the wrong drug or wrong dose, but also the omission of doses. The latter could be particularly relevant to antibiotics and the potential for subsequent perioperative infections.

COMMON MISTAKES

Medication errors may involve the wrong medication being administered, the wrong route of administration being used, or the wrong dose being administered. The latter is especially prevalent in pediatric patients related to calculation errors such as dosing the medication per pounds instead of kilograms, misplacing a decimal point, or a simple calculation mistake. A simple example of such are recent reports of acetaminophen overdose following the introduction of an intravenous preparation in the United States.¹⁴ A decimal place was put in the wrong place or the dose was administered as 10 ml/kg instead of 10 mg/kg. As the medication is supplied as a 10 mg/ml solution in a 100 ml vial, the overdoses resulted in a 10-fold excess of medication being administered. Fortunately, in this particular report, the mistake was noted and appropriate therapy with N-acetylcysteine provided.

Wrong medications may be administered related to syringe swaps, failure to identify the patient correctly before the medication is administered, and problems with look-alike vials. Copper et al. noted that syringe swaps were the most common cause of preventable mishaps in anesthesia care. As noted by the photographs in this month's issue of *Anaesthesia, Pain & Intensive Care*, the potential for mistakes related to look-alike vials may be increasing. The presence of these look-alike vials has increased recently with drug shortages and the need to switch manufacturers to obtain the needed medications. As we switch from one manufacturer to another and the vials change, the subconscious visual ability to distinguish one medication from another is eliminated. Additionally, with an increasing number of manufacturers producing the same medications, the number of vials increases as does the potential for look-alikes.

The potential for morbidity and even mortality related to these problems is obvious. As noted in the report of Hove

et al. from the Danish Patient Insurance Association, medications may lead the list as the number one cause of perioperative mortality.⁹ The 24 fatal cases that were analyzed were categorized by their underlying etiology including airway management, ventilation management, placement of a central venous catheter, medication error, transfusion error, infusion pump problems, and regional blockade. Of the 24 fatal cases, one-third or 8 were likely medication-related. This was in comparison to 4 deaths from loss of the airway and 4 from complications related to central venous line insertion.

STRATEGIES FOR PREVENTION

These incidents highlight the need for caution when drawing up medications or administering them. The problems in the operating room environment are magnified and made even more difficult as medications are often given in high acuity situations and may have to be given in an environment of poor visibility with multiple distractions.^{15,16} Medication errors are not usually caused by 'bad' practitioners, but are almost inevitably the result of system failures coupled with the failure of cognitive strategies employed by anesthetists to reduce this risk.

Of paramount importance in formulating strategies to reduce medication errors is the development of a non-blame environment where errors are openly reported and discussed without fear of retribution, penalties, or loss of employment. This allows for the identification of where the system failed, appropriate reporting of problems, and the development of strategies to prevent such incidents from recurring. These strategies may involve a brief discussion of those involved (a huddle) held the next day in the operating room before the cases start or a more lengthy process that investigates the entire system (root cause analysis). Without a no-blame environment, there may be decisions made to hide mistakes and not investigate them appropriately. Physicians may fear legal repercussions related to lawsuits, sanctions or the loss of employment. Failure to investigate will result in the inevitable repetition of mistakes. Additional initiatives to result in zero harm and eliminate all medical errors includes the empowerment of all medical personnel in the operating room and beyond to voice concerns when they believe actions may lead to patient harm. We must encourage all personnel including the technicians and nurses in the operating to immediately voice concerns. This has led to the development of a technique known as a "hard stop" so that any healthcare professional can call for an immediate cessation of all activity and a quick discussion and evaluation of the process if they believe harm could result to the patient.

When specifically dealing with medications, potential interventions have been suggested.¹⁷⁻¹⁹ We list and further elaborate on potential strategies suggested by Jensen et al.¹⁷:

1. The label on any medication ampule or syringe should be carefully read before the medication is drawn up or injected.
2. Syringes should be labeled (see below for more discussion on labeling syringes and the suggested information).
3. There should be a consistent means for the arrangement of medications, position of ampules and syringes, and the separation of similar or dangerous medications on the anesthesia workstation.
4. There should be double-checking of the medications before administration. This may be particularly important for medications with a narrow therapeutic index that are infrequently administered in an operating room setting such as digoxin and potassium. It may be prudent to have specifically policies regarding medications such as potassium which detail the amount to be administered and the timeframe of the infusion.
5. Errors in intravenous drug administration during anesthesia should be reported and reviewed.
6. A dedicated pharmacist should be appointed for the operating room.
7. Similar packaging and presentation of medications should be avoided where possible.
8. Medications should be available in prefilled syringes whenever possible.
9. Medications should be drawn up and labeled only by the anesthesia provider who will administer them.
10. Color coding by class of medication according to an agreed standard should be used.

Apart from all these recommendations, lighting of the operating room should be optimal. As noted from reviews of other adverse events in and outside of the operating room, fatigue definitely plays a role. In many countries, ongoing auditing of duty hours is mandatory to avoid prolonged shifts or excessive hours per week. Within the constraints of busy operating rooms and rapid turnover times in between cases, ample time should be provided to avoid the rushed preparation of medications. The latter may be mandatory during emergency situations.

When medications are administered, the 5 “rights of medication” should be followed, including;

1. The right patient
2. The right drug
3. The right dose
4. The right time and
5. The right route.

The later becomes particularly relevant in the operating room setting as the literature is replete with reports of inadvertent administration of the wrong medication into the intrathecal or epidural space. The consequences of which can be devastating even for a medication whose intravenous administration might be relatively innocuous.

SUMMARY

Medication errors continue to lead the list of preventable errors during hospitalizations. Depending on the medication administered and its route, the consequences can be devastating. As outlined in this editorial, various interventions may help prevent such problems. Of paramount importance is the labeling of all medications that are used in the operating room immediately upon their withdrawal from the vial. In the best scenario, preprinted labels are available which contain a space for the necessary elements including the medication, the concentration, the dilution and diluent (if used), the date and time that the medication is drawn up, the initials of the person drawing up the medication and the total amount drawn up into the syringe. The latter prevents using the same syringe on two patients. If two ml of atropine are drawn into a syringe and only one ml administered, it is feasible that the remaining one ml will remain in use for the next patient. By noting the amount initially drawn up, the anesthesia provider may note that the syringe has already been used. When drawing up medications, the vial should be double-checked. As noted by the photographs in the current issue of this journal, there are increasing similarities among the vials used to hold medications of diversely different classes. Medication errors should be voluntarily reported in a “no blame” environment to avoid for appropriate investigations and modifications of practice to prevent their recurrence. Involvement of the pharmacy department with a dedicated operating room pharmacist may be particularly useful in limiting these problems as the pharmacist may be helpful in preparing infusions and eliminating the need for the anesthesia provider to perform such tasks. Although medication labeling machines are available for use in the operating room setting which will provide preprinted labels for each syringe with all of the needed information thereby eliminating legibility issues, however, the cost of such machines may be prohibitive.

REFERENCES

1. Beecher HK, Todd DP. A study of the deaths associated with anesthesia and surgery: based on a study of 599,548 anesthetics in ten institutions 1948-1952, inclusive. *Ann Surg* 1954;140:2-35. [PubMed] [Free Full Text]
2. Wilson RM, Runciman WB, Gibberd RW, Harrison BT, Newby L, Hamilton JD. The quality in Australian Health Care study. *Med J Aust* 1995;163:458-71. [PubMed]
3. Webster CS, Merry AF, Larsson L, McGrath KA, Weller J. The frequency and nature of drug administration error during anaesthesia. *Anaesth Intensive Care* 2001;29:494-500. [PubMed]
4. Llewellyn RL, Gordon PC, Wheatcroft D, Lines D, Reed A, Butt AD, et al. Drug administration errors: a prospective survey from three South African teaching hospitals. *Anaesth Intensive Care* 2009;37:93-8. [PubMed]
5. Yamamoto M, Ishikawa S, Makita K. Medication errors in anesthesia: an 8-year retrospective analysis at an urban university hospital. *J Anesth* 2008;22:248-252. [PubMed]
6. Rivière A, Piriou V, Durand D, Arnoux A, Castot-Villepelet A. Medication errors in anaesthesia: a review of reports from the French Health Products Agency A. *Ann Fr Anesth Reanim* 2012;31:6-14. [PubMed]
7. Amor M, Benschir M, Belkhadir Z, Ghannam A, Azendour H, Drissi Kamili N, Maazouzi W. Medication errors in anesthesia: a Moroccan university hospitals survey. *Ann Fr Anesth Reanim* 2012;31:863-9. [PubMed]
8. Butala BP, Shah VR, Bhosale GP, Shah RB. Medication error: Subarachnoid injection of tranexamic acid. *Indian J Anaesth* 2012; 56:168-70. [PubMed] [Free Full Text]
9. Hove LD, Steinmetz J, Christoffersen JK, Moller A, Nielsen J, Schmidt H: Analysis of deaths related to anesthesia in the period 1996-2004 from closed claims registered by the Danish Patient Insurance Association. *Anesthesiology* 2007;106:675-80. [PubMed] [Free Full Text]
10. Shridhar Iyer U, Fah KK, Cong CK, Macachor J, Chia N. Survey of medication errors among anaesthetists in Singapore. *Anaesth Intensive Care* 2011;39:1151-2. [PubMed]
11. Currie M, Mackay P, Morgan C, Runciman WB, Sellen A, Webb RK, Williamson JA. The Australian Incident Monitoring Study. The "wrong drug" problem in anesthesia: an analysis of 2000 incident reports. *Anesthesia Intensive Care* 1993; 21:596-601. [PubMed]
12. Merry AF, Peck DJ. Anaesthetists, errors in drug administration and the law. *N Z Med J* 1995;108:185-7. [PubMed]
13. J 1995;108:185-7. [PubMed]
14. Cooper L, Nossaman B. Medication errors in anesthesia: A review. *Intern Anesth Clin* 2013;51:1-12. [PubMed]
15. Dart RC, Rumack BH. Intravenous acetaminophen in the United States: iatrogenic dosing errors. *Pediatrics* 2012;129:349-53. [PubMed] [Free Full Text]
16. Cooper JB, Newbower RS, Long CD, McPeck B. Preventable anesthesia mishaps: a study of human factors. *Anesthesiology*. 1978;49:399-406. [PubMed] [Free Full Text]
17. Cooper JB, Newbower RS, Kitz RJ. An analysis of major errors and equipment failures in anesthesia management: considerations for prevention and detection. *Anesthesiology* 1984;60:34-42. [PubMed] [Free Full Text]
18. Jensen LS, Merry AF, Webster CS, Weller J, Larsson L. Evidence-based strategies for preventing drug administration errors during anaesthesia. *Anaesthesia* 2004;59:493-504. [PubMed]
19. Eagle CJ, Davies JM, Reason J. Accident analysis of large-scale technological disasters applied to an anesthetic complication. *Can J Anaesth* 1992;39:118-22. [PubMed]
20. Gaba DM, Maxwell M, DeAnda A. Anesthetic mishaps: breaking the chain of accident evolution. *Anesthesiology* 1987;66:670-6. [PubMed] [Free Full Text]



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An emergency drive

Working as a locum at a very small rural hospital I was called in for an emergency surgery. I lived at a 30 minute drive from the hospital, but I was still there before the patient and her family arrived. I set up and went to the ER to wait. Soon there was a loud crash in the small parking lot nearby. We all ran out to see what had happened. It appeared that my incoming patient (only one in her family that could drive) had passed out and used my car to stop his vehicle. We got her out of the vehicle and rushed into the hospital, to surgery, and I am happy to report that she did just fine. My car survived too, and was later got repaired by her family.

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