

### Taking the confusion out of adrenaline

A 6 month old (8kg) child presented to an emergency department with anaphylaxis. Two doses of adrenaline were drawn up and administered to the patient intramuscularly (IM). Following this, it became apparent that two 1:1000 ampoules had been opened, prompting suspicion of multiple incorrect doses.

It was then recognized that a ten-fold dosing error had been made and that the patient had been administered two doses of adrenaline 800microg. (0.8 mL) of 1:1000. The correct dose of adrenaline in the treatment of anaphylaxis is 10 microg. /kg (0.01 mL/kg of 1:1000, up to 500 microg. (0.5 mL), which would have been 80 microg. (0.08 mL) of 1:1000. The infant required cardiac monitoring and admission to the ward, however was discharged after 48 hours.

Critically ill children are particularly vulnerable to medication errors with one of the most common errors involving an overdose<sup>1</sup>. Adverse medication incidents are a potential source of significant morbidity and mortality in children and infants, as dosages frequently rely on weight-based calculations.

The presence in the literature of ten-fold dosing errors associated with adrenaline in the literature is of great concern<sup>2</sup>. Calculating drug doses in critically ill children introduces a significantly increased risk of committing a prescribing error. Pre-calculated doses for commonly used medications for emergency situations should be readily available in all settings where critically unwell children present.

In a snapshot of medication errors involving adrenaline reported in IIMS over a period of 5 years (2014-2018), there were 21 separate incidents involving administration of the wrong dose. Seven of these incidents involved the management of cardiac arrest, while six were related to management of anaphylaxis.

The others related to infusion concentration errors and administration errors involving nebulised adrenaline in the management of croup. Of the 21 reported errors, more than half were ten-fold dose errors. There were three separate incidents involving the administration of the entire contents of a 1:10000 (10 mL, 1 mg) adrenaline ampoule to children in the management of cardiac arrest (as per management of adult cardiac arrest).

#### Potential factors contributing to these types of errors include:

- Adrenaline is available in 2 different concentrations, each containing 1 mg of adrenaline. This increases the risk of selection errors.
  - Adrenaline 1:1000 = 1 mg in 1 mL
  - Adrenaline 1:10000 = 1 mg in 10 mL
- Adrenaline is often prescribed as a ratio 1:1000 or 1:10000. The US Food and Drug Administration has recently requested changes in the labelling of adrenaline vials, prohibiting the use of ratios
- Doses may also be prescribed in micrograms (microg), milligrams (mg) or milliliters (mL). Conversions between these are confusing and can often lead to ten-fold dose errors
- Dose and route of administration of adrenaline changes according to the indication, i.e. cardiac arrest vs anaphylaxis which increases the risk of error
- Acutely ill children present to mixed emergency departments where medical and nursing staff may have had little exposure and experience with paediatric patients
- Doses are often given as a verbal order in an emergency rather than prescribed on a NIMC or resuscitation chart
- In the management of asystole, a ten-fold dosing error may be administered to a small child via a single syringe, and therefore may not provide the clinician with a visual cue to the error. Making the same error in an adult would require 10 prefilled syringes

#### The following strategies may reduce potential errors

**Electronic paediatric drug dose calculator programs** such as the NETS drug dose calculator and resources such as the Broselow® system have been shown to be a

more accurate and faster way of calculating resuscitation requirements than conventional methods, and can reduce the potential for serious medication errors.

#### Use of patients' own adrenaline autoinjector in hospital

in the treatment of anaphylaxis. This strategy has already been implemented in Victoria by 'Safer Care Victoria'. Work is underway to implement a similar plan in NSW.

**Anaphylaxis Kits** - A simple plastic container clearly labelled "Anaphylaxis Kit" and containing only 1:1000 ampoules and 1 mL syringes have been set up in a number of paediatric wards across NSW. This strategy provides a visual cue that a small volume is to be injected intramuscularly (max. dose 0.5 mL), reducing the risk of administering the incorrect dose.

**When prescribing adrenaline** it is recommended that the ratio, the dose in micrograms, and the volume in mL should all be included.

**Pre-printed labels** should be used where possible and doses should be separated into individual syringes, with each being immediately labelled.

**Clear communication in any resuscitation is critical.** This includes the name of the drug, dose required, strength and route. All medications must be checked by two clinicians accredited to do so. A **closed loop of communication** directed at the clinician ordering the medication is also an important step in reducing errors in highly stressful environments e.g. "I am giving 300 micrograms of adrenaline IV, which is 3 mL of 1:10000, can I proceed?"

#### References

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- Koren G, Barzilay Z, Greenwald M. Tenfold errors in administration of drug doses: a neglected iatrogenic disease in pediatrics. *Pediatrics.* 1986;77(6):848-849

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