Oxymetazoline Toxicity Under Anesthesia and Proposed Mechanisms for Safer Delivery

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Abstract

Oxymetazoline nasal spray is not FDA approved for use in children less than 6 years; however, its safety and efficacy are widely accepted and it is in widespread use in children prior to procedures that may lead to epistaxis, including naso-tracheal intubation. We report a case of intraoperative oxymetazoline toxicity in a 4 year old and discuss the mechanism by which a large dose of oxymetazoline may have been unintentionally administered to our patient. Our testing indicates that bottle position during oxymetazoline administration can routinely cause up to a 75-fold increase in intended drug administration.

CASE PRESENTATION

A 4 year old 14kg male with a past medical history significant for developmental delay and failure to thrive in the setting of a chromosomal 1q21.1 deletion presented for dental care under general anesthesia, with a planned naso-tracheal intubation.

After an uneventful mask induction with oxygen, nitrous oxide and sevoflurane a 1 mL syringe. Various atomizer devices, as shown below, can then aid in use by anesthesiologists and otolaryngologists who must perform procedures that lead to epistaxis. To improve patient safety, it will be important to develop an alternate mechanism for delivering the proper dose of oxymetazoline to supine, anesthetized patients.

When oxymetazoline must be administered to a supine patient, alternate mechanisms are available and can readily be used. A known and appropriate volume of oxymetazoline can readily be drawn up into a 1 mL syringe. Various atomizer devices, as shown below, can then aid in appropriate deposition on the nasal mucosa.

References:

IN VITRO STUDY - METHODS

We investigated the possibility that the position of the spray bottle can affect the quantity of oxymetazoline delivered. Although the spray bottle is designed for use with the tip in an upright position, application in a supine anesthetized patient requires inversion of the bottle to deliver oxymetazoline into the nares.

We measured the volume of oxymetazoline delivered when the bottle was squeezed in the upright and in the inverted position. To accomplish this, we weighed the bottle of oxymetazoline before and after use.

In the upright position, we tested 4 bottles, dispensing 5 sprays from each bottle.

In the inverted position, we tested 3 bottles, dispensing 3 sprays from each bottle.

We also measured the size of a drop of oxymetazoline dispensed by carefully squeezing the bottle in the inverted position.

Table 1: Single spray of oxymetazoline bottle in upright position (volumes in µL)

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<tr>
<th>Bottles</th>
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</tbody>
</table>

Mean volume of all trials = 28.9 ± 6.8 µL

IN VITRO STUDY - RESULTS

The quantity of oxymetazoline delivered with each spray in the upright and inverted position was measured (Tables 1 and 2).

Upright bottle: average volume = 29 µL ± 6.8 µL (Table 1)

Inverted bottle: average volume = 1037 ± 527 µL range of 470-2190 µL (Table 2)

In the inverted position, we noted that rather than a fine spray, the oxymetazoline was delivered as a stream of fluid. In contrast to the upright position, the volume dispensed with each squeeze in the inverted position was entirely dependent upon effort.

We also found that a single drop of oxymetazoline from an inverted bottle was 30 µL.

Table 2: Single spray of oxymetazoline bottle in inverted position (volumes in µL)

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<tr>
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Mean volume of all trials = 1037 ± 527 µL

DISCUSSION

Oxymetazoline was the only vasoactive agent administered prior to the hypertensive episode. Therefore, we feel confident that systemic absorption and toxicity of oxymetazoline was the cause of the hypertensive episode. Although oxymetazoline is a potent α2 agonist, it also exhibits weaker α1- adrenergic effects.2

Our patient exhibited physical signs that were consistent with exposure to an α1 agonist, including abrupt onset of action, slow resolution over 1 hour, reflex bradycardia, and secondary signs of increased systemic vascular resistance.

Our observations indicate that the use of nasal spray bottles to deliver oxymetazoline to patients in the supine position can easily lead to an unintentional medication overdose. Inversion of the bottle can lead to a 75-fold higher volume delivered compared to the upright position.

CONCLUSIONS

Oxymetazoline or other α agonist medications are likely to remain in widespread use by anesthesiologists and otolaryngologists who must perform procedures that lead to epistaxis. To improve patient safety, it will be important to develop an alternate mechanism for delivering the proper dose of oxymetazoline to supine, anesthetized patients.

When oxymetazoline must be administered to a supine patient, alternate mechanisms are available and can readily be used.

A known and appropriate volume of oxymetazoline can readily be drawn up into a 1 mL syringe. Various atomizer devices, as shown below, can then aid in appropriate deposition on the nasal mucosa.