

The Dead Space in Soha, Atlas and VMED Syringes: Is it a Cause of Inadvertent Overdose in Neonates

Dear Editor,

There are not enough available data to show that newborn infants more likely experience adverse reactions to drugs than adults. A lack of awareness or attention to critical aspects of drug administration techniques can result in therapeutic misadventures. One of the most common potential errors in drug administration techniques is inappropriate dilution.^{1,2}

When we noticed symptoms of phenobarbital and digoxin overdose in our patients which was confirmed by laboratory tests, an investigation was carried out aiming at disclosing the causes. Review of the nursing practice in our hospital suggested that the overdosing was due to the undetermined drug in the dead space of a 1 ml syringe.

Usually when a non-diluted drug solution is drawn up in a 1 ml syringe up to the desired point and injected directly, an amount of drug is retained in the dead space of the syringe, but no overdose is delivered. However when diluents are drawn up into the syringe, the medication may be drawn up in the dead space, resulting into an overdosing status.

According to the standards of the Institute of Standard and Industrial Research of Iran, the dead space volume can be up to 0.07 ml in a removable-

needle and 0.01 ml in a non-removable-needle of a 1 ml syringe.³ A research project carried out in Islamic Azad University, Tehran Medical Branch in 2009 to determine the actual dead space in removable (Atlas syringe®) and non-removable-needles of 1 ml syringes (Soha syringe®). The results indicated to a dead space of $0.054.85 \pm 0.013.15$ and $0.05.3 \pm 0.02.2$ ml respectively. Moreover, the dead space in removable needles of 1 ml syringes with a T-shape plunger seal (V MED syringe®) was $0.021.05 \pm 0.09.17$ ml (Figure 1).

These dead spaces in the delivered drug to the neonates were 1.35 to 4.7 fold more than the calculated dose,^{4,5} e.g. in a 2 kg neonate receiving 5 µg digoxin intravenously (250 µg/ml), the required drug volume would be 0.02 ml which is drawn up in a 1 ml syringe up to the 0.02 ml marking point. While drawing up the diluent, the drug in the dead space is also drawn up resulting in receiving 0.09 ml digoxin instead of a dose of 0.02 ml.⁴ To avoid this inadvertent overdosing in neonates, pre-diluted drug formulations are required as follows:

Method A by drawing up the required volume in a 1 ml syringe and transferring into another syringe with a larger volume, leaving the dead space drug



Fig. 1: Three types of syringes: Atlas, V MED and Soha syringes from top to bottom.

behind the first syringe which is not a closed system, Method B by choosing the syringes with the least dead spaces. A non-removable-needle in a 1 ml syringe (Soha syringe®) was shown to have the least dead space volume. If a fixed needle is not used, the second choice was the removable needle in 1 ml syringes with a T-shape plunger seal (V MED syringe®) and Method C by adding in calculation of the remained drug in the dead space of the syringes. Although no life threatening reports were available in the literature on dead spaces in the syringes, this inadvertent dosing error may have a potential of serious adverse effects in patients.

Keywords: Dead Space; Syringes; Overdose; Neonate

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Conflict of interest: None declared.

F Zonouzi

Department of Pediatrics, Islamic Azad University, Tehran Medical Branch, Bu-Ali Hospital, Tehran, Iran

*Correspondence: Farzaneh Zonouzi, MD, Department of Pediatrics, Islamic Azad University, Tehran Medical Branch, Bu-Ali Hospital, Tehran, Iran. Tel: +98-912-2601685, Fax: +98-21-33786180, e-mail: farzanehzonouzi@yahoo.com

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