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DOSING ERRORS DUE TO FLOW RATE VARIABILITY IN MULTI-INFUSION THERAPY SETUPS: COMPARISION BETWEEN A SYRINGE PUMP AND A CYLINDER PUMP

Kwan Young Hong[1], Hyeryung Kang[1], Joongbum Cho[2], Jong-Hwan Lee, [1] and Jeong Jin Min[1*]

1 Department of Anesthesiology and Pain Medicine, Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, Korea
2 Department of Critical Care Medicine, Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, Korea

Introduction

- In critically ill patients, multiple drugs or fluids are often infused through the same line simultaneously. Several previous studies reported on dosing errors due to flow interactions when multiple drugs with various flow rates are infused through the same line. However, a newly developed cylinder pump, which combined the advantages of infusion- and syringe pump, would prevent free flow or siphoning phenomenon, allowing more accurate drug delivery without being affected by the surrounding environment.

Objective/Aims

- The aim of this study was to compare a new generation cylinder pump with a conventional syringe pump to check for dosing errors of slow-rate drug when infused through the same line with the rapid-rate drugs.

Methods

- ***Quantitative analysis of free-flow using vertical displacement***

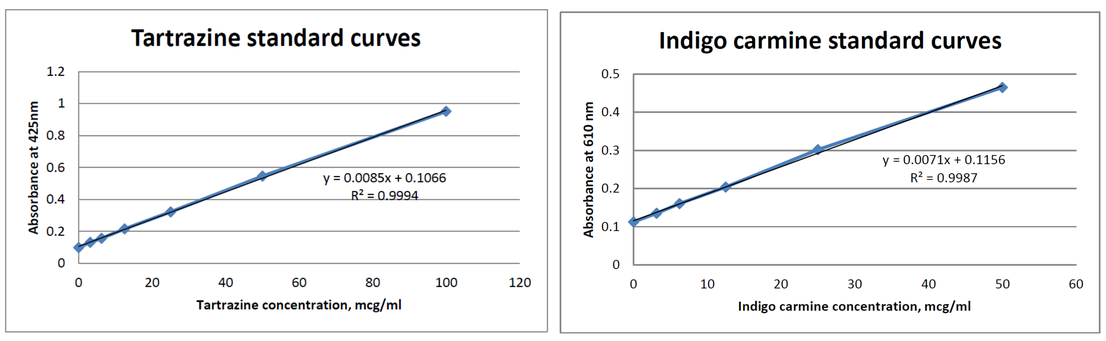
To prove the free-flow and back-flow in different infusion pump settings, zero-drug delivery time (ZDDT) and infusion bolus (IB) were recorded after elevating (60cm) and lowering (60cm) the pump position.

- ***Effects of co-infusion***

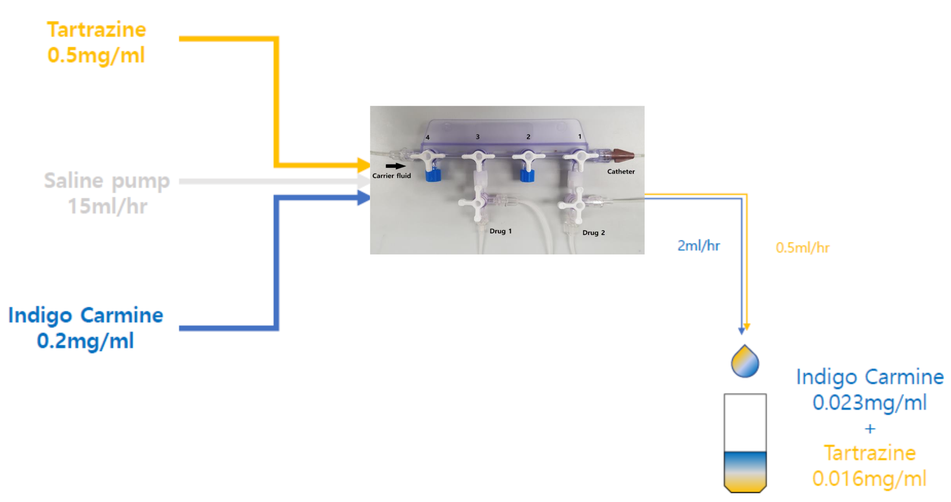
A visible dye (tartrazine) infused at a rate of 0.5 ml/hr was used as a model drug. Experiment was setup to model a clinical drug delivery system through a four-stopcock linear manifold and a catheter lumen. The rate of carrier fluid was fixed at 15ml/hr. After the first drug (tartazine) reached a steady-delivery state, second drug (Indigo carmine) with a 2ml/hr rate was initiated.

The dye delivery was quantitatively measured by a spectrophotometer. Experiments were conducted with the conventional syringe pump (Injectomat MC Agilia, Fresenius Kabi) and a new generation cylinder pump (H-100, Meinntech), respectively. Each experiment was repeated three times.

- **Figure 1. Standard curve validation experiments.**

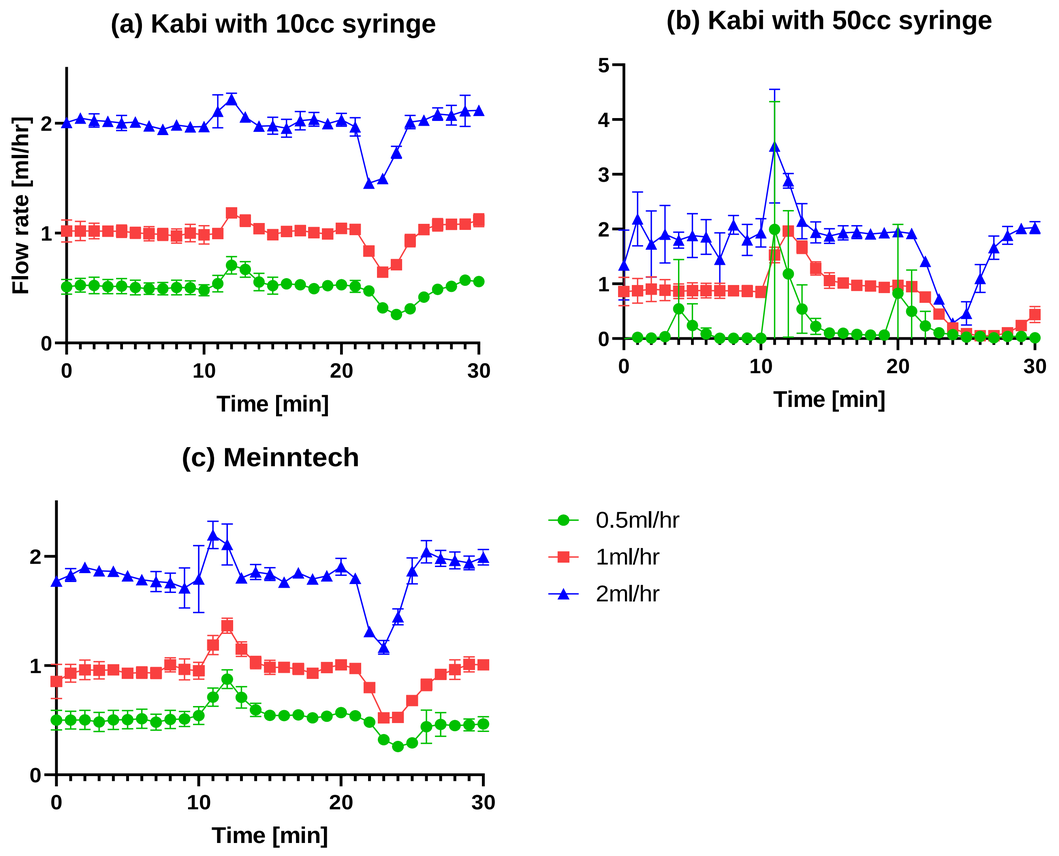


- **Figure 2. Experimental manifold set up with vent mechanism.**



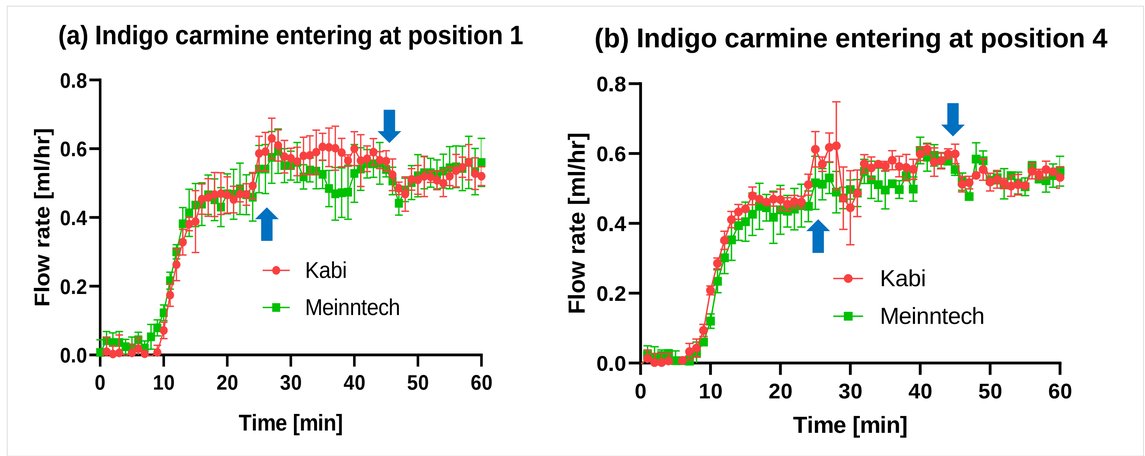
Results

- **Figure 3. Tartrazine delivery with vertical displacement of pump position. (a) Kabi with 10cc-sized syringe, (b) Kabi with 50cc syringe, (c) Meinntech**



The Kabi pump with 10cc-syringe and Meinntech cylinder pump showed comparable results with IB and ZDDT. However, in case of using a 50cc-syringe in the Kabi pump, significant under-infusion in the slow-rate setting (< 1ml/hr), relatively large IBs and ZDDTs were observed.

- **Figure 4. Tartrazine delivery by continuous infusion: effect of indigo carmine co-infusion. Tartrazine infusion was initiated at 5 minute. Once the tartrazine infusion reached a steady-state, indigo carmine infusion was initiated via (a) manifold port 1 or (b) manifold port 4.**



In the multi-infusion setups, starting and stopping the second drug infusion caused an unintentional, transient over-dosing and under-dosing in the first drug delivery, respectively. However, in case of the cylinder pump, its own cartridge acted as an anti-reflux valve to prevent free-flow and siphoning phenomenon.

Conclusion

Regardless of the used infusion device, delivery of one infused drug was transiently affected by starting or stopping a second drug infusion in the same line. Accidental free-flow and siphoning phenomenon may be reduced in the cylinder pump.

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