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Improving healthcare professionals' awareness on mechanical phlebitis contributed by combination of venous access devices uses.

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Introduction

Phlebitis rate among admitted patients is a clinical indicator that is associated with patient safety. One reasons for the rising indicator could be attributed to the lack of awareness on the impact on the use of venous access devices.

This quality improvement project looks at the use of various intravenous devices that are available and used in Sengkang General Hospital and how the different combination of devices contribute to pressure exerted on the endothelial wall of peripheral blood vessels. Endothelial capillary pressure is known to be about 25mmHg (34 cmH_2O) (Shore, 2000).

Methodology

Simulated models of 10 possible combinations of devices (Figure 1) connected to intravenous cannula are established as procedure setup to examine the amount of pressure that would be exerted onto the endothelial tissues intravascularly. Cannula of gauge 22 (22G, blue) is used in procedure 1 to 5 and gauge 20 (20G, pink) in procedure 6 to 10. Pressure measurement is captured by the Fluke pressure meter gauge reading cmH_2O.

Fluid boluses of 60mL, using water for injection and Dextrose 50% fluid were administered through each procedure setup. A final pressure reading is obtained through an average of 9 separate pressure readings (Figure 3).

To eliminate operating error and pressure variations caused by end users, a syringe pump is used to deliver the bolus volume.

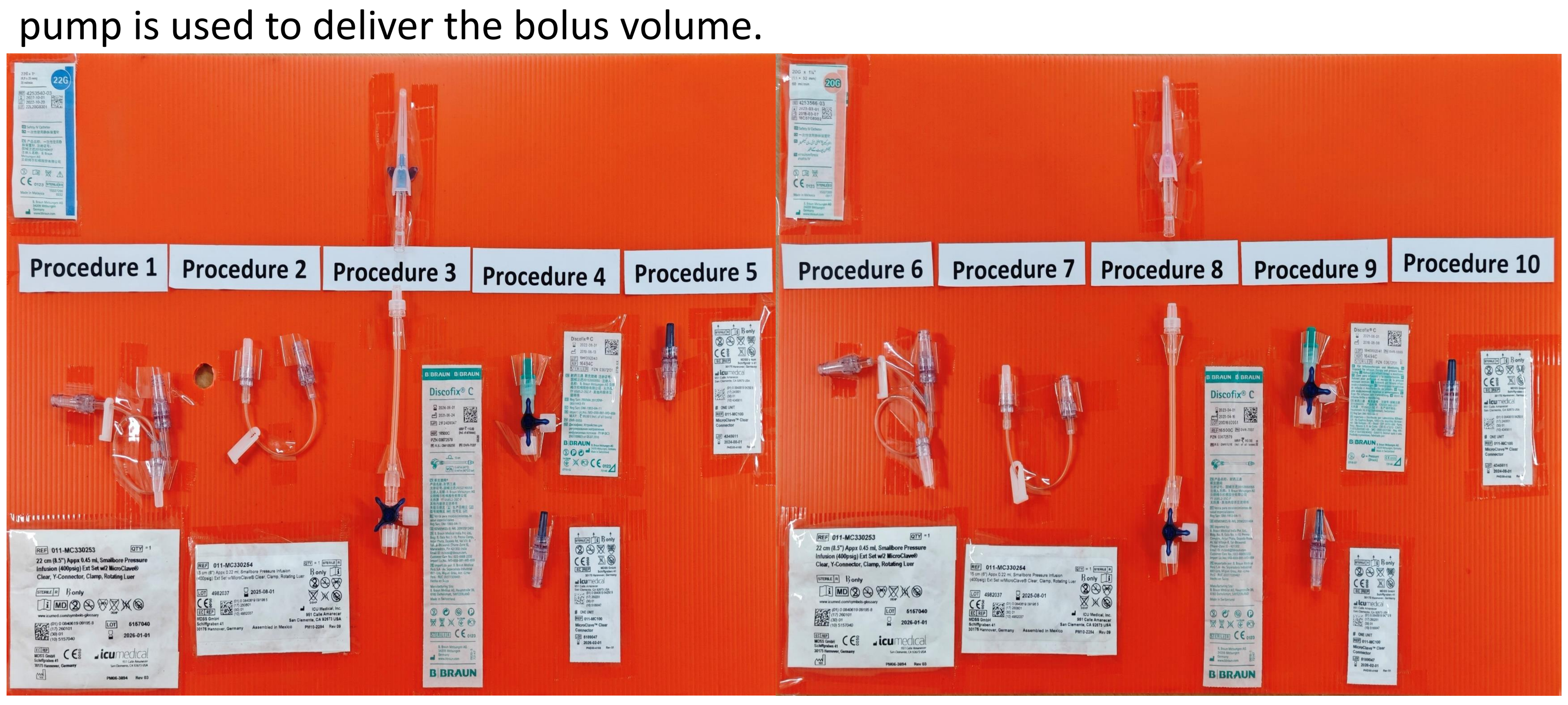

Figure 1: Combination of IV devices as procedure setup.

Results

The following tests were carried out to compare common intravenous administration methods:

Test	Comparison	Observations
1	Devices	All procedures generated infusion pressure that is higher than end capillary endothelial pressure (i.e. more than 34 cmH_2O) (Figure 2). 22G cannula produces higher pressure than 20G cannula.
2	5mL & 10 mL Saline-filled Syringe	Pressure seem to increase over the duration of administration with the highest pressure towards near finishing of the bolus administration. 5mL syringe generates a typical of 245 cmH_20 and 10mL at 375 cmH_20.
3	Bolus by hand and Syringe Pump (using 60mL of 50% glucose fluid)	The syringe pump generated a lower pressure in average; this is likely due to a more consistent pressure throughout delivered by the pump unit. Fluid administration by hand generates higher pressure and is likely to contribute damage to endothelial tissues.
4	Addition of Infusion Line	Inclusion of a 200cm infusion line of between the infusion method and the cannula shows a reduced in pressure.

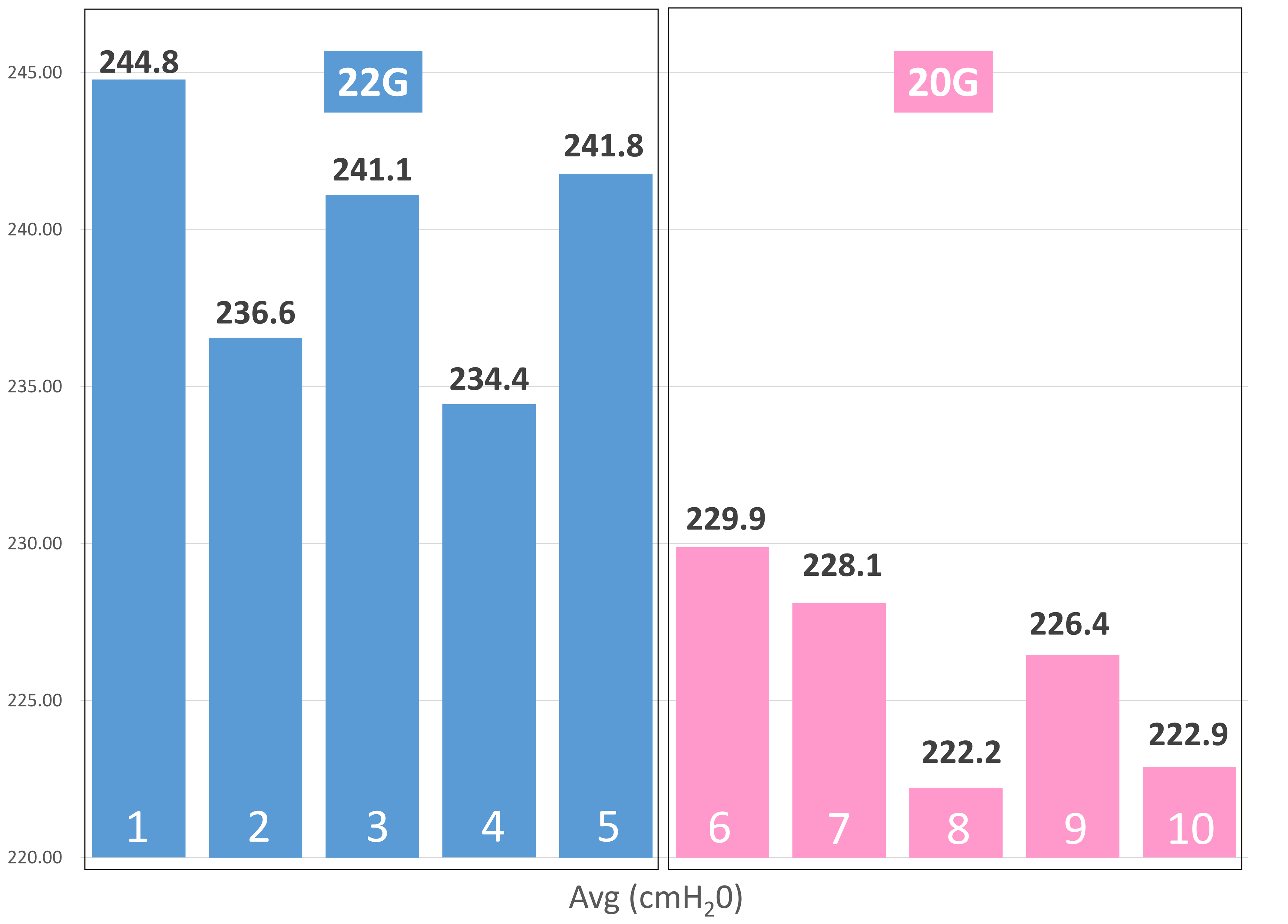

Figure 2: Pressure Comparison Chart – All Procedures

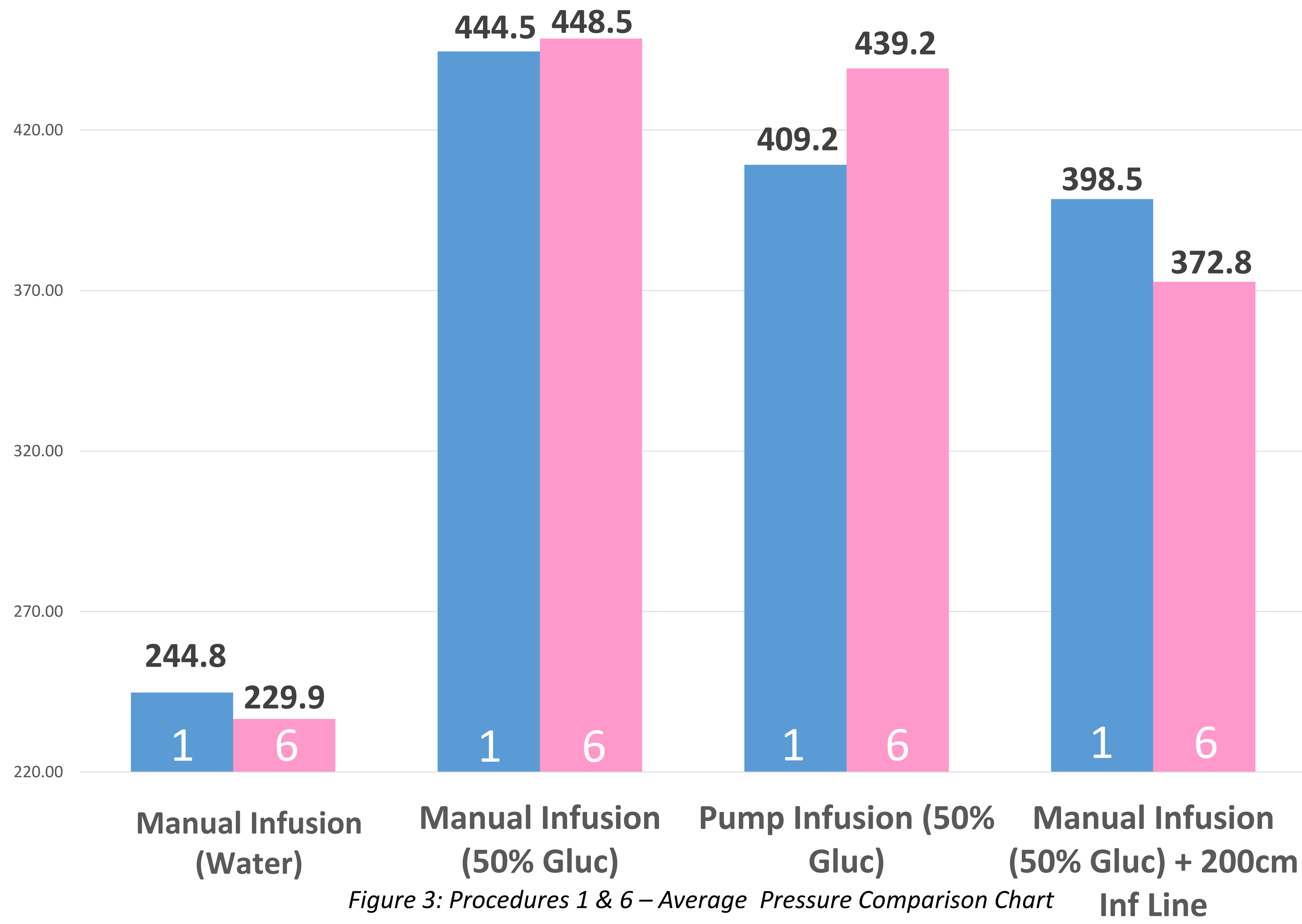

Figure 3: Procedures 1 & 6 – Average Pressure Comparison Chart

Conclusion

The project conclude with the following insights that help to streamline SKH internal procedure guidelines and training instructions:

1. Infusion volume will affect the end-cannula pressure. Hence, large volume infusion are scheduled over a duration span than bolus dosing through peripheral cannula.
2. Manual bolus administration result in inconsistent pressure and usually derive in much higher pressure than bolus delivered by the pump unit.
3. Denser liquids require higher administration force which result in higher pressure hence, a pump unit with adequate duration span for delivery could mitigate harm to endothelial wall.
4. Large volume infusion is best delivered via an infusion line and gravity flow as advocated by the reduced pressure.
5. 22G cannula produces higher infusion pressure as compared to 20G cannula; hence, 20G is a more favorable device that mitigates phlebitis.
6. Potentially can aim to reduce infusion pressure of 22G down to 20G.

Reference

Shore AC. Capillaroscopy and the measurement of capillary pressure. Br J Clin Pharmacol. 2000 Dec;50(6):501-13. doi: 10.1046/j.1365-2125.2000.00278.x. PMID: 11136289; PMCID: PMC2015012.