

COMPARISON OF BLOOD REFLUX IN A STANDARD SYRINGE AND 2 DIFFERENT BRANDS OF SALINE FLUSH SYRINGES

INTRODUCTION

The term blood reflux refers to blood that is aspirated into the distal tip of a VAD (Vascular Access Device) after the clinician has relaxed the pressure on the syringe plunger. The injection pressure applied to the plunger at the completion of the flush procedure and the design of the syringe piston are two critical factors that contribute to blood reflux.

The higher the applied pressure on the piston at the end of the flush procedure the more blood will be drawn back into the catheter, when the pressure is relaxed on the syringe plunger. Differences in syringe piston design will also contribute to blood reflux. The more the piston can "bounce back" in the barrel when the pressure is relaxed at the end of the flush procedure, the more blood will be drawn back into the catheter. Complications related to blood reflux include catheter occlusion by fibrin or thrombus formation.

TEST METHOD

A reflux test method was developed that measures the amount of a red solution that is aspirated into a catheter over time, once the force on the syringe plunger is relaxed. The pressure that was applied to the plunger was varied in order to ensure that the test procedure reflects actual clinical practices. A 4 French catheter was flushed multiple times with 3 different brands of syringes. One of the brands of syringe is a commonly available sterile empty syringe that is used for injections (Terumo™). The other two brands are syringes that were specifically designed for flushing VAD's (MedXL Advantage™ and BD PosiFlush™). In order to eliminate lot to lot variability, two different lots were tested from each brand of syringe. The variable that was measured was the length of colored solution that is aspirated into the catheter at different plunger forces. The time that the force was maintained on the plunger before release was 3 seconds. The testing apparatus consisted of a fixture that maintains the syringe position constant throughout the test procedure and an apparatus that can measure an applied force at different speeds. A 4 French catheter is attached to the syringe and a controlled force is applied to the plunger of the syringe. The controlled force will depress the plunger at the desired speed. When the plunger reaches the end of the injection, the force is maintained for a period of 3 seconds. As the force is relaxed solution will aspirate back into the catheter. The length of solution that is aspirated back into the catheter is then measured.

RESULTS

Testing revealed that solution reflux in a standard syringe (Terumo™) is significant. This is expected since standard syringes were not designed to minimize blood reflux during flushing. Syringe brands that were designed specifically for VAD flushing (MedXL Advantage™ and BD PosiFlush™) were equivalent and displayed no solution reflux except at very high pressures, one of the syringe brands (BD Posiflush™) had a small length of solution reflux. The results which have been averaged for simplicity are shown in Table 1. Figure 1 is a picture showing the significant amount of solution reflux that occurs with the standard syringe, whereas Figure 2 and 3 shows no solution reflux when flushing syringes are used.

CONCLUSION

The results indicate that, at the very least, institutions should avoid the practice of preparation and use of certain brands of standard syringes to flush VAD's due to the significant amount of blood reflux and the subsequent complications as a result of the blood reflux into the VAD. The results also indicate that there is no difference in solution reflux between the two brands of syringes that were specifically designed for flushing VAD's. (MedXL Advantage™ and BD PosiFlush™).

TABLE 1 Solution reflux length in a 4 French catheter at different applied pressures

Applied Force (Pounds)	Terumo™ Solution reflux length (Applied Pressure-psi)	MedXL Advantage™ Solution reflux length (Applied Pressure-psi)	BD PosiFlush™ Solution reflux length (Applied Pressure-psi)
5	8 cm (17 psi)	0 cm (18 psi)	0 cm (19 psi)
10	20 cm (33 psi)	0 cm (36 psi)	0 cm (38 psi)
15	25 cm (50 psi)	0 cm (55 psi)	0 cm (58 psi)
20	35 cm (67 psi)	0 cm (73 psi)	0 cm (78 psi)
25	>35 cm (83 psi) (solution refluxes back into luer hub on catheter)	0 cm (91 psi)	1 cm (97 psi)

FIGURE 1, 2 and 3. Solution reflux in a 4Fr catheter at 10 pounds of force from various syringes

<p>Figure 1. An example of a standard syringe (Terumo™) that has significant blood reflux due to the fact that it is not designed for flushing VAD's.</p>	<p>Figure 2. An example of a Flush Syringe (MedXL Advantage™) which has minimal blood reflux because it has been designed for flushing VAD's.</p>	<p>Figure 3. An example of a Flush Syringe (BD PosiFlush™) which has minimal blood reflux because it has been designed for flushing VAD's.</p>

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