

## Syringe Size and Catheter Flushing

### Question:

Our policy requires a 10 ml syringe or larger for catheter flushing but does not mention giving other medications with smaller syringes. Why are large syringes necessary? Should large syringes be required when administering all medications from a syringe?

### Answer:

This is a common question that requires an understanding of flow, pressure, and resistance to flow. Large amounts of pressure can lead to ruptured or fractured catheters and all product literature include warning statements about high pressure injection. It is imperative to follow the statements for the brand of catheter being used. Some companies make syringe size recommendations while others have instructions to not exceed a certain amount of pressure, usually 40 pound per square inch (psi). A recent study demonstrated hand injection of contrast media with a 12 ml syringe ranges between 35 to 91 psi, demonstrating pressures well beyond that recommended by most catheter manufacturers. (1) Therefore limiting injection to large size syringes may not create the safe harbor that most think that it is.

As a general guide, nurses are taught that larger syringes generate smaller amounts of pressure during injection while smaller syringes generate greater amounts of pressure during aspiration. When the catheter lumen is totally patent, pressure will not increase. Instead the injected fluid will flow freely through the lumen and into the vein. However, if resistance is felt and additional force is applied to the plunger of the syringe, the pressure inside the catheter lumen could reach a level high enough to cause catheter damage.

Flow through any catheter is dependent upon a pressure gradient. For fluid flow to occur, the pressure at the external catheter hub must be greater than the pressure at the internal catheter tip. This pressure gradient can be achieved by gravity, electronic infusion controlling devices, and manual injection from syringes. When the height of the fluid container is between 36 to 48 inches, the pressure will be about 2 psi. Electronic infusion controlling devices have occlusion pressures between 5 and 10 psi with the pumping pressure less than the occlusion pressure. When injecting fluid from syringes, the caregiver has no way to measure the amount of pressure applied to the syringe plunger. It seems contradictory to use larger syringes for flushing procedures when smaller syringes are needed for medication delivery. Dosages of heparin, insulin, digoxin, steroids, antiemetics, and narcotics could require fractions of a milliliter. The nature of these drugs mandates accurate measurement that is impossible with large syringes. Neonatal and pediatric dosages also require small volume and accuracy. Some nurses report measuring the dose with a small syringe, then transferring the medication to a large syringe for injection. However part of the volume could be lost in this transfer and the potential for contamination increases with each step.

Another strategy would be to assess catheter patency with a saline flush in a large syringe followed by medication injection from a small syringe. It is critical to remember that

encountering any resistance during a manual injection with any syringe size mandates that the injection be stopped. Clinical assessment should include the condition of the site, sutures, and dressing; evaluation of all medications and techniques used; length of catheter dwell time, original tip location, and any changes in the external catheter length. Many factors impede fluid flow through a catheter including fibrin or drug precipitate accumulating in the lumen, the fibrin sheath around the catheter tip, and pinch-off syndrome.

1. Ruess L, Bulas DI, Rivera O, Markle BM: In-line pressures generated in small-bore central venous catheters during power injection of CT contrast media. *Radiology* 1997; 203(3): 625-629.

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