Flow rate performance

MaxPlus® needleless IV connector

Introduction

Ninety percent of all hospitalized patients receive intravenous therapy. From a bolus of fluid delivered in the ER to reduce the complications of dehydration, to the delivery of medications and nutrition in the ICU, providing intravenous therapies in the correct dose depends in part on the flow rate of therapeutic fluid delivered to the patient through a catheter. Fluid delivery rates will vary significantly based on the type of therapy, patient size and fluid requirements. For example, critical care of neonatal patients require extremely low flow rates often maintained by accurately calibrated infusion pumps, sometimes as little as 0.5 mL per hour. Fluid delivery to catheterized patients in the ICU may vary from as low as 10 mL per hour for maintaining an open line, to higher flow rates required for fluid replacement. The most commonly placed IV cannula are 20-22G, used for IV maintenance, IV antibiotics and IV analgesia for maintenance flow typically less than 2 liters per hour. It is well documented that the fluid flow rate to the patient can be dramatically altered based on the types of intravenous fluid delivery devices used. A long administration set or a catheter with a small inner diameter will create restrictions to flow rate that may substantially reduce fluid delivery. The use of large bore tubing sets and catheters will facilitate higher fluid delivery rates. Needleless access devices are commonly used to cap intravenous catheters and are accessed to administer fluids to the patient. It has been suggested that these devices add restriction to the IV administration set and may further decrease flow rate.

Objective

To determine the flow rate of needleless connectors and their effect on catheter flow rate in order to provide clinicians with an accurate assessment of needleless access device flow rates and capabilities with regard to intravenous fluid delivery.

Procedure

ISO standards establish the guidelines for infusion set performance and methods to test performance characteristics. The testing procedure in this study was designed utilizing the ISO standard to accurately determine flow rate. The test measures the flow rate of a device accessed by a male luer lock through a standard bore IV administration set at a 39” head height. The flow rate is determined based on time required to collect 60 mL of solution. This measurement is then converted to L/hr. Measurements reflect an average flow rate of a sample size of five devices.

In addition to testing the flow rate of needleless connectors, testing was performed to determine the flow rate of two catheter sizes commonly used in clinical settings and the effect of a connector on catheter flow rate. A Becton Dickenson Insyte 22G catheter was selected as the test catheter most representative of peripheral intravenous catheter use. The Bard PowerPicc SOLO dual lumen 6 Fr catheter was selected as representative of central venous catheter use. Fluid flow rate was measured at gravity and at a pressure of 300 mm/Hg, created using a standard pressure infusion cuff, simulating the infusion rate required for massive transfusions and rapid fluid replacement.
### Test results discussion

The results in the preceding tables illustrate that needleless connectors in most cases do not significantly impact fluid flow rate through the catheter. The variable exerting the most impact on flow rate is the catheter itself, which causes restriction to fluid delivery when compared to the free flow rate of a simulated IV administration set.

The MaxPlus needleless connector delivers a flow rate of 219 mL/hr, equivalent to a 14G catheter, which is substantially higher than most other connector designs. One study found that a 140 mL/min flow rate was sufficient to stabilize most patients in trauma situations requiring massive transfusions.

Common practice in trauma cases is to establish two patient IV lines, or to insert a large catheter into a large vein and connect the administration set directly to the catheter hub in order to establish a high rate of infusion. Trauma requirements such as these are infrequent, far outnumbered by more common intravenous delivery requiring lower administration rates.

### Flow rates measured through standard bore administration set with needleless access connector attached

### Conclusion

The MaxPlus needleless connector accommodates a comprehensive range of intravenous administration requirements and is suited to virtually all clinical applications. From the low fluid requirements of neonatal and KVO (“keep the vein open”) therapy to infusions requiring a high rate of delivery, the MaxPlus clear connector can facilitate optimal intravenous fluid administration.