

The Impact of Single Valve and Positive Pressure Valve Connectors on Occlusions in Children with Central Venous Catheters

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Problem

Central Venous Catheter (CVC) occlusions represent the most common catheter complication that the CVC Resource RN's at CCHMC are requested to manage. Catheter occlusion rates average 9% or approximately 30-40 episodes per month. Catheter occlusions can delay treatment, incur additional expenses, increase nursing workload, and result in potential loss of the catheter.

Background

There are multiple factors that can predispose catheters to occlusion; reflux of blood into the catheter has been shown to play a significant role. Current literature supports the use of valve technology as a way of decreasing incidence of occlusion (1). Occlusion can be defined as complete (the inability to flush or aspirate) or partial (the inability to aspirate).

Needless cap connectors with valves are designed and promoted with different characteristics including those with single valve design and positive pressure valve design.

Needless Connector Cap Characteristics

Single Valve Design (SmartSite)	Positive Pressure Valve Design (MaxPlus)
• Needleless Adaptor	• Needleless Adaptor
• Valve Septum	• Positive Pressure Valve
• Blood and Lipid Compatible	• Blood and Lipid Compatible
• Easy Blood Draw	• Flat Swabable Surface
• Easy Luer Tip Connection	• Designed to Eliminate Retrograde Blood Flow
	• Highest Flow Rates of Positive Pressure Devices



Theoretical Framework

A Model for Change to Evidence-Based Practice by Rosswurm and Larrabee (2).

Research Questions:

In Children with Central Venous Catheters:

Would the use of this positive pressure valve device decrease the incidence of catheter occlusion when compared to a single valve?

Which device would result in greater user satisfaction?

Would the use of this positive pressure valve device affect the catheter related infection rate?

Method

■ CVC Lumens were prospectively capped with 1 of 2 connector devices in a two phase sequential design.

- Phase 1- Lumens were capped with the single valve device Alaris SmartSite
- Phase 2- Lumens were capped with the positive pressure valve device Medegen MaxPlus

■ Catheter Lumens had to be capped for a minimum of 3 days.

■ Heparin Flush protocols were utilized for both phases:

- Phase 1 Protocol: flush, clamp, disconnect
- Phase 2 Protocol: flush, disconnect, clamp

■ All caregivers were educated on specifics of cap function, use and appropriate flush protocol.

■ Study patients were located on selected inpatient units.

■ Demographic Data collected by the Research Team:

- Gender and Age (months)
- # of Catheter Lumens per patient
- # Catheter days
- Catheter type

■ Outcome Data:

- All complete and partial occlusions were evaluated by the research team.
- Related blood stream infections were evaluated by the infection control co-investigator (NH) using standard CDC definitions.
- User satisfaction surveys, using a 1 to 5 Likert Scale, were distributed and completed near the end of each study phase.

Results

■ Phase 1: Single Valve study group included 164 CVC lumens with a cap duration of 11.6 days, a complete occlusion rate of 11% and a partial occlusion rate of 10.4%.

■ Phase 2: Positive Pressure Valve study group included 172 CVC lumens with a cap duration of 10.9 days, a complete occlusion rate of 6.9% and a partial occlusion rate of 19.8%.

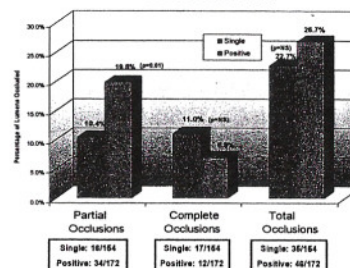
■ Satisfaction survey results showed that user satisfaction was higher in all 9 questions in the Single Valve study group in comparison to the Positive Pressure Valve study.

■ Infection results showed an infection rate of 1.1/1,000 device days in the Single Valve study group versus 4.3/1,000 device days in the Positive Pressure Valve study group (p=NS).

Patient Study Characteristics

	Single Valve Device	Positive Pressure Device
# Lumens	154	172
M/F	81/73 (1.1)	91/81 (1.1)
Age (months)	88.2	81
Mean # Catheter Lumens	1.5	1.6
Mean # Catheter Days in Study	11.6	10.9
Total # Catheter Days in Study	1790	1879
# Cap Days in Study	2231	2117

Occlusion Results



Results



Conclusion

■ A statistically significant increase was found in the partial occlusion rate in the Positive Pressure Valve study group.

■ There was a trend toward a reduction in the complete occlusion rate in the Positive Pressure Valve study group. However, this finding did not reach statistical significance.

■ Overall, there was no statistical difference in total (complete plus partial) occlusion rates between the 2 groups.

■ A four-fold increase in the infection rate was found in the Positive Pressure Valve study group, however this did not reach statistical significance. We estimate that a larger study of 450 devices per group would be required for adequate power to detect a statistically significant difference in this outcome variable.

■ The satisfaction survey results showed a significant difference in satisfaction with Positive Pressure Valve study group devices as compared to Single Valve study group devices.

Significance of Findings

Based on the results of this study, the data did not support any change of clinical practice. Due to increased partial occlusion rates, reduced nursing satisfaction and concerning trends in infection rates, a decision was made to continue with the current needless valve connector device and our search for a better solution.

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