COOK®

Physical Characteristics of Drainage Catheters

A COMPARATIVE STUDY

Introduction and Objective

Various factors can hinder or delay the successful drainage of abscesses, such as the location and configuration of the abscess, the nature of the infecting organism, host resistance, fistulous connections and viscosity of the abscess contents.[1] Drainage catheters provide an effective treatment to overcome these known obstacles by delivering consistent flow rates.

The flow of fluids through a drainage catheter is governed by Poiseuille's Law, which describes the rate of laminar flow of fluid through a cylindrical structure. The Poiseuille Law is expressed by the following equation:

$Q = Pr \pi r^4 / 8 \eta L$, where

- Q is the flow rate,
- Pr is the pressure gradient between the two ends of the catheter,
- r is the radius of the catheter,
- L is the length of the catheter and
- η is the viscosity of the fluid.[2]

The most important factor in the application of this law is the dramatic effect of changing the radius.[3] Since the radius is a very influential variable in Poiseuille's Law, the amount of flow is limited by the smallest cross-sectional area of the cylinder. Careful attention must be paid to the radius of drainage catheter circuits, specifically to physical elements such as hub-to-catheter fittings, stopcock manifolds and sideports. Data suggests that stopcock connections greatly influence the efficiency of the percutaneous drainage systems. Stopcocks with larger inner diameters may improve drainage over that achievable with the stopcocks that are currently available.[4]

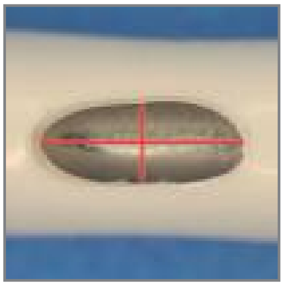
The objective of this paper is to present the results of a comparative study conducted by MED Institute on the dimensional characteristics of drainage catheters. The drainage catheters tested were the Cook Ultrathane® Mac-Loc® Multipurpose and the Boston Scientific Flexima™ Regular APD™ catheters. The following dimensional features were examined:

· Sideport Area
· Hub Internal Diameter (I.D.)

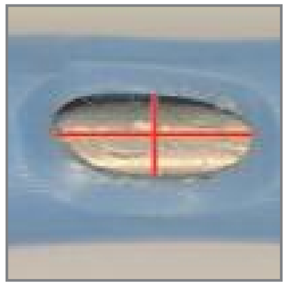
Area of Sideports

Test Method

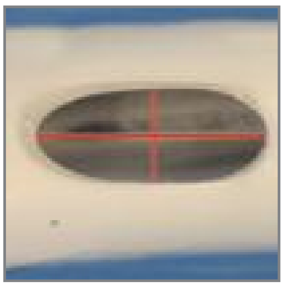
To determine sideport area, two sideports on each device — one near the distal tip and one near the proximal hub — were measured with a light microscope and a calibrated image measurement system. Twenty drainage catheters in both 8 and 12 French sizes* of each manufacturer were measured to determine the area of sideports.



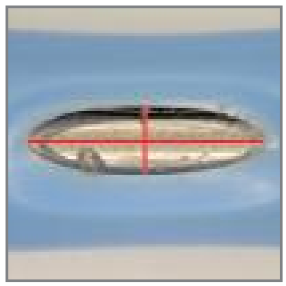
Cook 8 Fr | 3.09 ± 0.19 mm²



Boston Scientific 8 Fr | 2.47 ± 0.29 mm²



Cook 12 Fr | 5.25 ± 1.10 mm²



Boston Scientific 12 Fr | 5.20 ± 0.48 mm²

Results

In both 8 and 12 French sizes, the Cook catheters were found to have larger sideports than their Boston Scientific counterparts. Cook's sideports in the 8 French devices were 20% larger than the sideports in Boston Scientific's 8 French devices. In the 12 French sizes, Cook's sideports were nominally larger, by 1%. The table below summarizes the test findings.

MANUFACTURER	8 FRENCH	12 FRENCH
Cook Incorporated	3.09 ± 0.19 mm²	5.25 ± 1.10 mm²
Boston Scientific	2.47 ± 0.29 mm²	5.20 ± 0.48 mm²

Hub Internal Diameter

Test Method

One catheter of each manufacturer was measured inside the hub, which is one of the smallest areas of the drainage catheter. The 8 and 12 French catheters were tested by a pin gauge to obtain the exact measurements of the hub internal diameter (I.D.).

Results

In both 8 and 12 French sizes, the Cook catheters were found to have progressively larger hub internal diameters than their Boston Scientific counterparts. Cook's hub I.D. in the 8 French devices was 21% larger than Boston Scientific's 8 French devices. In the 12 French sizes, Cook's hub I.D. were signifigantly larger by 33%. The illustrations demonstrate the test findings.

Cook 8 Fr | .131 mm   Boston Scientific 8 Fr | .103 mm

Cook 12 Fr | .134 mm Boston Scientific 12 Fr | .103 mm

Conclusion

As results indicated, Cook drainage catheters offer larger sideport area and hub internal diameters than the Boston Scientific drainage catheters. Further examination may be warranted such as flow rate testing.

* The catheter French sizes reported on the manufacturers' label are not of actual size. The outer diameter of these catheters was measured for precise calculations. The following table illustrates the actual dimensions of both the 8 and 12 French catheters from each manufacturer.

MANUFACTURER	LABEL SIZE	ACTUAL SIZE
Cook Incorporated	8.5 Fr	8.47 Fr
	12 Fr	11.58 Fr
Boston Scientific	8 Fr	8.50 Fr
	12 Fr	12.27 Fr

[1] Lee, KH et al. Clogging of Drainage Catheters: Quantitative and Longitudinal Assessment by Monitoring Intracatheter Pressure in Catheters and Rabbits. Radiology 2003; 227: 833-838.

[2] Sammett EJ et al. Basic Fluid Dynamic Principles-Application to Percutaneous Intervention. EMedicine® March 2004.

[3] Nave, C.R. Pressure: Poiseuille's Law. http://hyperphysics.phy-ast.gsu.edu Copyright: C.R. Nave, 2005.

[4] D'Agostino HB et al. (Department of Radiology, University of California, San Diego). Influence of the stopcock on the efficiency of percutaneous drainage catheters: laboratory evaluation. American Journal Roentgenology 1992 Aug: 159(2): 407-9.

See Also:
Park, JK, Kraus, FC, Haaga, JR. Fluid Flow during Percutaneous Drainage Procedures: An *in vitro* Study of the Effects of Fluid Viscosity, Catheter Size and Adjunctive Urokinase. American Journal of Roentgenology 1993 Jan: 160(1): 165-9.

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