Guide Catheter Surface Treatment to Minimize Endovascular Trauma

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Background
Guide catheters (GC) are routinely utilized to access endovascular sites to deliver balloons, stents, coils, guidewires, and contrast agents. The GC can cause frictional damage to intra-vascular walls, and can initiate thrombosis. Previously published studies indicate that reduced catheter-on-catheter friction associated with increased surface polarity is quite persistent. The purpose of this investigation was to determine whether reduced friction of GC on vascular wall surfaces could be achieved while also retaining critical surface tension (CST) values associated with minimal thrombosis.

Materials & Surface Characterization
Guide Catheters (GC) – new; 4 different brands from supplies of the Toshiba Stroke Research Center (Univ. Buffalo); designated as GC-A, -B, -C, -D.

Vascular Tissue – preserved human umbilical cord vein grafts with known, blood-compatible surface properties

Lubricating Fluid - physiologic saline

GC Surface Characterization – comprehensive contact angle analyses (to determine CSTs, polarities and surface energies) and MAIR spectroscopy (to determine surface chemical compositions)

Catheter Modification
Each of the 4 catheter types (GC-A to –D) was evaluated in 3 conditions:

- AR: as-received
- DW: washed with lab detergent & rinsed with distilled water
- PT: DW’d, then gas-plasma-treated (2min, air, Harrick PDC-32G)

Coefficient of Friction [CoF]
Pin-on-disk friction device – catheter segment held in place on vertical column over saline-lubricated interior surface of vascular graft; graft was fixed to the reciprocating stage of the apparatus

- experimental set-up addresses static CoF, which is relevant to the endovascular use of guide catheters
- device was calibrated with 10 different loads before catheter-on-tissue tests were initiated
- normal loads were placed on the vertical column; 5 different normal loads were used (30-70g)

Results and Conclusions
- GC-A, -B, and –C had CST values between 20 and 30 mN/m (values previously associated with minimal thrombogenicity)
- All 4 types of catheters (as-received) had different types of manufacturer-applied coatings that variably transferred to the MAIR test plate during analysis.
- After DW treatment, catheters had slightly increased CSTs and water contact angles, providing evidence for partial to complete removal of the manufacturer-applied coatings. MAIR-IR spectra indicated retained hydration in surface zones.

- Each DW catheter's CoF was somewhat greater than the value for the AR catheter. The CoF of each PT catheter was markedly less than the values for the AR and DW catheters.

- Simple increases in hydrophilicity are not sufficient to account for these results; the highest PT CoF was for GC-D, which had the lowest water contact angle.

- The manufacturer-applied coatings did not produce CoF as low as the gas-plasma-treated catheters.

- Treating as-manufactured GC with gas-plasma could produce surface zones of high polarity -- maintaining thromboresistant qualities while decreasing friction between the catheter and the vascular wall.