Comparison of Antimicrobial Needleless I.V. Connectors in a Septum Contamination Assay

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Statement of Purpose:

The introduction of needleless intravenous (I.V.) connectors (NCs) in the 1990s lead to the desired dramatic decrease in I.V. associated needlestick injuries to healthcare providers; however, this introduction has been accompanied by an increase in catheter-related bloodstream infections (CRBSI).[1] This increase in CRBSI has had large negative effects on patient morbidity and mortality and carries an estimated cost between $34,000 and $56,000 per episode.[2]

A common feature of NCs is an elastomeric septum that provides the physical barrier between the catheter lumen and the environment. Microbe contamination of this septum has been implicated as a source of CRBSI and accordingly programs and protocols have been established to promote disinfection of these septa.[3] Recent studies have shown that when disinfection procedures are followed contamination can persist in a substantial number of cases.[4] This in combination with inconsistent disinfection practices suggests that other techniques may be necessary to reduce the occurrence of CRBSI.

One strategy pursued by multiple NC manufacturers has been to impregnate the septa with an antimicrobial agent. It is the purpose of this present study to compare the effectiveness of the various antimicrobial NCs in an *in vitro* assay for septum contamination.

Methods:

Four different antimicrobial eluting NCs were examined in the present study along with their corresponding non-antimicrobial twin [Max Guard ™ with Antimicrobial Technology (Maximus, Ontario, CA), Ultrasite® Ag Antibacterial Luer Access Device (Braun Medical, Bethlehem, PA), Antimicrobial Clave® (ICU Medical, San Clemente, CA), and InVision-Plus® CS™ (RyMed Technologies Franklin, TN)]. Clinical bacterial contamination to the NCs was simulated by pipetting, on top of the septum, a 10 µL solution of saline containing approximately 10^5 colony forming units (CFU) of the following clinically significant organisms: *A. baumannii*, *E. coli*, *E. faecalis*, *K. pneumoniae*, methicillin-resistant *S. aureus* (MRSA), *P. aeruginosa*, *S. aureus*, and *S. epidermidis*. After 30 min the each NC was sufficiently vortexed in saline to remove any bacterial contamination remaining on the septum surface and appropriate dilutions were plated on blood-agar plates to determine the number of CFU. The experiment was conducted in at least three independent replicates and the total number of remaining CFU was compared to the initial inoculate and to the non-antimicrobial eluting controls.

Results:

Of the four NCs examined InVision-Plus® CS™ (RyMed Technologies Franklin, TN) was the only NC that displayed measurable antimicrobial activity under the conditions employed. It reduced the bio-burden on the exposed surface by at least three logs for all bacteria tested compared to its non-antimicrobial twin. The other three NCs [Max Guard ™ with Antimicrobial Technology (Maximus, Ontario, CA), Ultrasite® Ag Antibacterial Luer Access Device (Braun Medical, Bethlehem, PA), and Antimicrobial Clave® (ICU Medical, San Clemente, CA)] provided a complete recovery of the total surface contamination and showed no measureable reduction in the bio-burden compared to their non-antimicrobial twin.

Conclusions:

As septum contamination has been implicated as a source of CRBSI associated with NCs,[3] we sought to design and perform an *in vitro* assay to replicate the bio-burden NCs may face in a health care environment. Bacterial surface contamination was simulated by inoculating the exposed septum of the various NCs with multiple bacterial species of clinical significance. The reduction in microorganisms for each antimicrobial NC was determined after a short time period (30 min) as may be relevant in a health care environment. Interestingly, only one antimicrobial NC, InVision-Plus® CS™ (RyMed Technologies Franklin, TN), resulted in a reduction in CFU under the conditions employed. This likely reflects differences in the material used to manufacture the exposed septum and the corresponding kinetics of antimicrobial release. Such a reduction in bio-burden on the exposed surface of the NC is expected to translate into a reduction in organism counts exiting the distal end of the device and entering the catheter. While the *in vitro* reduction in bio-burden of the InVision-Plus® CS™ (RyMed Technologies Franklin, TN) antimicrobial NC is demonstrated herein, the clinical efficacy of this treatment strategy has not been established and future work is needed to relate this or other *in vitro* assays with clinical data.

References:

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2.) Jarvis WR. Clin Infec Disease. 2009; 49:1821-1827.

3.) Menyhay SZ. Am J Infect Control. 2008; 36: S174. e1-5.

4.) Menyhay SZ. Infect Control Hosp Epidemoiol. 2006; 27:23-28