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Editorial

What does really affect the colonization of needleless connectors?

¿Qué afecta realmente a la colonización de los conectores sin aguja?

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The study published by Delgado et al., in the present issue of Enfermedades Infecciosas y Microbiología Clínica entitled: "Positive pressure needleless connectors did not increase rates of catheter hub colonization respecting the use of neutral pressure needleless connectors in a prospective randomized trial", demonstrates that the use of positive-pressure nedleeless connectors (NCs) did not result in significantly more hub colonization rates respect to neutral-pressure NCs (13.4% vs. 14.6%).[1] This could mean that maybe not only the NCs' design or the valve type is relevant, but also other factors unrelated to the NCs, such as NC design, correct hub manipulation, and NC disinfection.

Closed NCs have proven useful in the prevention of hub contamination and their use is recommended by the IDSA Guidelines.[2,3] However, when central venous catheters (CVCs) are inserted for more than 8 days, infection can occur by an intra-luminal route (66%) because of hub contamination. Hub colonization after manipulation is responsible for 29–60% of catheter-related infections.[3]

The key point in hub contamination relays on biofilm formation. Biofilms begin to form on CVCs within hours after catheter insertion by developing a conditioning layer with plasma proteins, platelets and neutrophils attached, to which bacteria can easily adhere.[4,5]

Hub colonization can be conservatively detected (without NCs removal) by superficial cultures (combination of skin and hub cultures).[3,6] However, scrubbing the internal surface of hubs carries the risk of biofilm dislogde to the bloodstream causing infection. Recently, flushing withdrawn NCs has been demonstrated to be an alternative and safer diagnostic technique for detecting hub colonization in combination with skin superficial cultures.[7]

The main issue regarding NCs' colonization relays on its design, which is still under discussion, as Delgado et al. demonstrate in their study.[1] There are several *in vitro* and *in vivo* studies assesing whether the type of valve systems of NCs are the main reasons for the potential colonization of these devices. Originally, positive-pressure-valve NCs demonstrated to be associated to lower colonization rates. Schilling et al. demonstrated in a prospective and comparative study that those CVCs capped with a single-valve or positive-pressure-valve NCs had lower catheter occlusion rates that those capped with a standard device (<5% vs. 12.7%). However, they did not find differences in infection rates between different NCs groups. They found that lower infection rates were more related to the use of heparinized saline.[8] Yebenes et al. demonstrated that positive-pressure valve NCs had significantly lower hub colonization rates than conventional caps used for radial arterial catheters inserted into critically ill patients (2.4% vs. 20.5%, $p = 0.03$).[9] In addition, an *in vitro* study comparing 8 different NCs showed that 3 positive-displacement mechanical valves were associated with the ingress of significantly fewer microorganisms compared with other devices.[10] However, current Prevention Guidelines recommend the use of neutral-valve NCs, as they demonstrated to prevent occlusions and infections.[11–13]

In the multicenter surveillance study for health-care associated bloodstream infections (HA-BSI) it was demonstrated that HA-BSI rate increased significantly when split septum NCs were replaced by mechanical valve NCs (6.15 vs. 9.49 BSIs per 1000 CVC days, $p < 0.001$).[14] In addition, Yebenes et al. demonstrated in an *in vitro* study, that the barrier effect of disinfectable NCs was adversely affected by incorrect handling.[15]

Moreover, another *in vitro* study showed that the optimal scrubbing technique for NC disinfection was scrubbing an access port in a straight line using an alcohol cotton swab, applying a force that was almost equal to an arterial compression haemostasis to the access port, and repeating this procedure once using a new cotton swab.[16]

Finally, an observational before-after trial in an oncology unit, central line-associated bloodstream infection was reduced from 2.3 to 0.3 infections/1000 CVC days ($p = 0.03$) when hub care was changed from cleaning with alcohol wipes to using alcohol-impregnated port portectors.[17]

Therefore, there is not a single main factor associated to hub colonization, but to the set of several factors composed of correct handling, valve design, and NC disinfection with alcohol.

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In addition, the design of the NC is important not only to reduce colonization, but also to prevent occlusions in the catheter and to protect healthcare personnel from punctures and sprays, especially when handling cytostatics. Therefore, it is important to know the design of the connector (access type-Split-septum, preferably fluid laminar flow to avoid turbulences, type of displacement, as well as other specifications: dead space, compatibility, etc.).[18] Thus, the occlusion of the catheter is related to the NC design, being the anti-reflux valves those that have been shown to be related to less reflux in *in vitro* studies and, therefore, they are recommended when long-term CVCs are used.[19] Another important factor of NC is the dead space of the connector, specially when they are inserted in newborns. Also, dialysis catheters need to use high flows.[20]

In conclusion, the role of NCs in the pathogenesis of catheter hub colonization is still under discussion. There are several *in vitro* and *in vivo* studies trying to demonstrate whether type of valve or NC design are intrinsically involved in the appearance of infection. However, not only these factors could be associated to hub contamination, but also other extrinsic factors. It is also mandatory to monitor not only catheter infections but also obstructions. We must know the NC design and it is needed to assess the lack of complications by clinical studies.

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