Factors influencing local signs at catheter insertion site regardless of catheter-related bloodstream infections

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To the editor,

Little is known on the role of local signs at the catheter exit site [1–3]. Using a large cohort with high-quality data from four randomized-controlled trials we recently showed that local signs at insertion site (i.e., a composite endpoint including redness, pain, purulent and non-purulent discharge) were significantly associated with catheter-related bloodstream infections (CRBSI) [4]. However, a question remains open: Which factors may influence local signs regardless of CRBSI? To our knowledge, no data in the recent literature are available.

We therefore re-analyzed our large cohort with 6976 patients and 14,590 short-term catheters, and we used as a primary endpoint “≥1 local sign.” We used multivariable logistic regression in order to identify variables associated with ≥1 local sign. Logistic models were stratified for the different centers included in the analysis.

Importantly, patients over 75 years (OR 0.82, 95% CI 0.72–0.94, \(p=0.0044\)), with high SOFA score (OR 0.66, 95% CI 0.55–0.79, \(p<0.001\)), immunosuppression (OR 0.72, 95% CI 0.59–0.88, \(p=0.0014\)), catheter duration ≤7 days (OR 0.30, 95% CI 0.27–0.34, \(p<0.001\)), and jugular (OR 0.62, 95% CI 0.49–0.80, \(p=0.0001\)) or femoral (OR 0.76, 95% CI 0.64–0.90, \(p=0.0012\)) sites significantly decreased the risk to develop local signs (Table 1) regardless of CRBSI. Clinicians should deserve particular attention to these specific populations of critically ill patients, who may decrease the risk of developing local signs. Among patients with CRBSI (\(n=114\)), severely injured patients (i.e., with high SOFA score or under vasoactive medications), immunosuppressed patients and femoral catheters had fewer local signs (data not shown).

In our previous analysis, we found that local signs observed within the first 7 catheter-days are predictive for intravascular catheter infections [4]: We are convinced that especially in this subgroup clinicians should be aware of the frequent absence of local signs in elderly, severe, immunosuppressed patients, and jugular/femoral catheters in the decision-making process.

Interestingly, pathological temperature (body temperature ≥38.5 °C or ≤36.5 °C), catheter type, and severity of illness in the presence of local signs did not help clinician in predicting intravascular catheter infections [4]. In light of all these considerations, we summarized in Table 2 practical clinical implications that may help ICU specialists when dealing with local signs and suspicion of intravascular catheter infections.
Table 1  Risk factors of having ≥ 1 local sign (multivariable logistic regression)

| Risk factor                              | OR     | 95% CI     | p value     |
|------------------------------------------|--------|------------|-------------|
| CRBSI                                    | 4.242  | 2.811      | <0.0001     |
| Male sex                                 | 1.093  | 0.981      | 1.218       |
| Age > 75 years*                           | 0.823  | 0.719      | 0.941       |
| SOFA score*                              | 0.719  | 0.587      | 0.881       |
| Catheter days ≤ 7                        | 0.303  | 0.273      | 0.336 <0.0001|
| Catheter type, CVC (versus AC)           | 1.057  | 0.875      | 1.277       |
| Experience of the operator < 50 procedures | 0.945  | 0.842      | 1.062       |
| Insertion site                           |        |            |             |
| Jugular                                  | 0.623  | 0.488      | 0.796       |
| Subclavian                               | 1.018  | 0.801      | 1.292       |
| Femoral                                  | 0.755  | 0.637      | 0.895       |
| Vasopressor at insertion                 | 0.961  | 0.853      | 1.083       |
| Antibiotic at insertion                  | 1.271  | 1.138      | 1.420       |

Bold: statistically significant

*The log linearity was not respected for SOFA and age, and therefore, we created two qualitative variables.

CRBSI: catheter-related bloodstream infection. OR: odds ratio. CI: confidence interval. IQR: interquartile range. ICU: intensive care unit. SOFA: Sequential Organ Failure Assessment. CVC: central venous catheter. AC: arterial catheter.

Table 2  Practical clinical implications

Factors that independently decreased local signs at insertion site: Older age
Severe ill patients
Immunosuppression
Catheter maintenance ≤ 7 days
Jugular and femoral sites

Factors that decreased local signs in patients with CRBSI
Severe ill patients
Immunosuppression
Femoral site

Factors influencing the management of catheter*
Redness, non-purulent discharge, and purulent discharge are significantly associated with CRBSI
Local signs are absent in almost 60% of CRBSI
Local signs observed within the first 7 days are highly predictive for intra-vascular catheter infections
Pathological temperature (body temperature ≥ 38.5 °C or ≤ 36.5 °C), catheter type, and severity of illness in the presence of local signs do not help clinician in predicting intravascular catheter infections

*see reference [4]

CRBSI: catheter-related bloodstream infection.

Abbreviations
CRBSI: Catheter-related bloodstream infections; CVC: Central venous catheter; ICU: Intensive care unit; OR: Odds ratio; SOFA: Sequential organ failure assessment.

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NB, SR, and JFT analyzed and interpreted the data. OM, BS, JCL, OM were responsible for the data collection. NB and JFT were the major contributors in writing the manuscript. All authors read and approved the final manuscript.

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All studies were approved by the national ethics committees.

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References
1. Safdar N, Maki DG. Inflammation at the insertion site is not predictive of catheter-related bloodstream infection with short-term, noncuffed central venous catheters. Crit Care Med. 2002;30(12):2632–5. https://doi.org/10.1097/01.CCM.0000037966.19604.25.
2. Armstrong CW, Mayhall CG, Miller KB, Newsome HH Jr, Sugerman HJ, Dalton HP, et al. Clinical predictors of infection of central venous catheters used for total parenteral nutrition. Infect Control Hosp Epidemiol. 1990;11(2):71–8.
3. Pittet D, Rae AC, Auckenthaler R. Clinical diagnosis of central venous catheter line infections: a difficult job. Abstract 453. Programs and abstracts of the 31st Interscience Conference on Antimicrobial Agents and Chemotherapy. Washington D.C.: American Society for Microbiology, 1991. 1991.
4. Buetti N, Ruckly S, Lucet JC, Bouadma L, Garrouste-Orgeas M, Schwebel C, Mimoz O, Souweine B, Timsit JF. Local signs at insertion site and catheter-related bloodstream infections: an observational post hoc analysis using individual data of four RCTs. Crit Care. 2020;24(1):694. https://doi.org/10.1186/s13054-020-03425-0.

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