Intensive Care Med (2022) 48:1422–1425
https://doi.org/10.1007/s00134-022-06763-5

SPECIAL ISSUE INSIGHT

Update on prevention of intra-vascular accesses complications

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In the intensive care unit (ICU), intravascular access is mandatory for monitoring and prompt resuscitation. However, mechanical complications at insertion, and infections or thrombosis during catheter use remain frequent, with an incidence of more than 60 episodes for 1000 catheter-days [1]. Therefore, catheter use should be guided by necessity, always preferring the device with the lowest complication rate or the less invasive one.

Choice of the intravascular access

In the most severely ill patients, the choice of peripheral vs central venous line (CVL) remains difficult. Even if the CVL utilization ratio is 70.1% of the patient-days in Europe, the decision of CVL insertion should be carefully balanced with the risk of complications (Fig. 1). Ultrasound insertion should be used to limit mechanical complications, especially in case of internal jugular and subclavian insertion. However, strict aseptic surgical conditions should be adopted to prevent the risk of infections suggested by post hoc analyses of randomized controlled trials (RCTs) [2]. Femoral access, associated with a similar risk of infectious complications and a higher risk of thrombosis with respect to jugular access, should be used in case of hemostasis disorders [3]. Similarly, ultrasound guidance can also be used to maximize successful cannulation of midline, peripherally inserted central catheters (PICCs) and peripheral veins in patients with difficult or tenuous vascular access.

Given the risk of mechanical complications on insertion and the increased infectious and thrombotic complications with longer dwell times, de-escalation to the less invasive devices or avoiding central access altogether must be considered for all patients.

Catheter insertion during the week-end or nighttime, when caregivers are fewer or more tired, does not increase the risk of infection and does not justify early catheter removal [4].

Vasopressor administration via peripheral intravenous catheters (PIVCs) is feasible with an acceptable safety profile [5]. It may allow a prompt initiation of therapy with vasopressors and avoid the insertion of a CVL [6]. Routine (96 h) vs as needed PIVC replacement to prevent catheter-related bloodstream infection (CRBSI) remains a controversial issue for ICU patients [7, 8].

Midline catheters and PICCs are available as single or multi lumens for patients requiring longer term or more reliable access. They are inserted via peripheral veins of the upper limb, with midlines terminating at or below the axillary vein, and PICCs having their tip at the cavoatrial junction, similar to CVLs. Compared with CVLs, PICCs are more prone to dislodgement, malfunction and risk of deep venous thrombosis (DVT) [3, 9]. Compared with midlines, PICCs have a lower adjusted risk of DVT, but a higher risk of CRBSI and occlusion [10]. The use of these devices increases in the ICU and might be an option before transfer to step-down units.

Key prevention measures of catheter infections

Prevention of CRBSI can be achieved following a set of measures used in combination ("bundles", Fig. 1). Caregivers education and training combined with the use of checklists increase knowledge of and adherence to guidelines. Continuous follow-up of processes and outcome indicators associated with participation in networks reinforces the efficacy of prevention programs [3].

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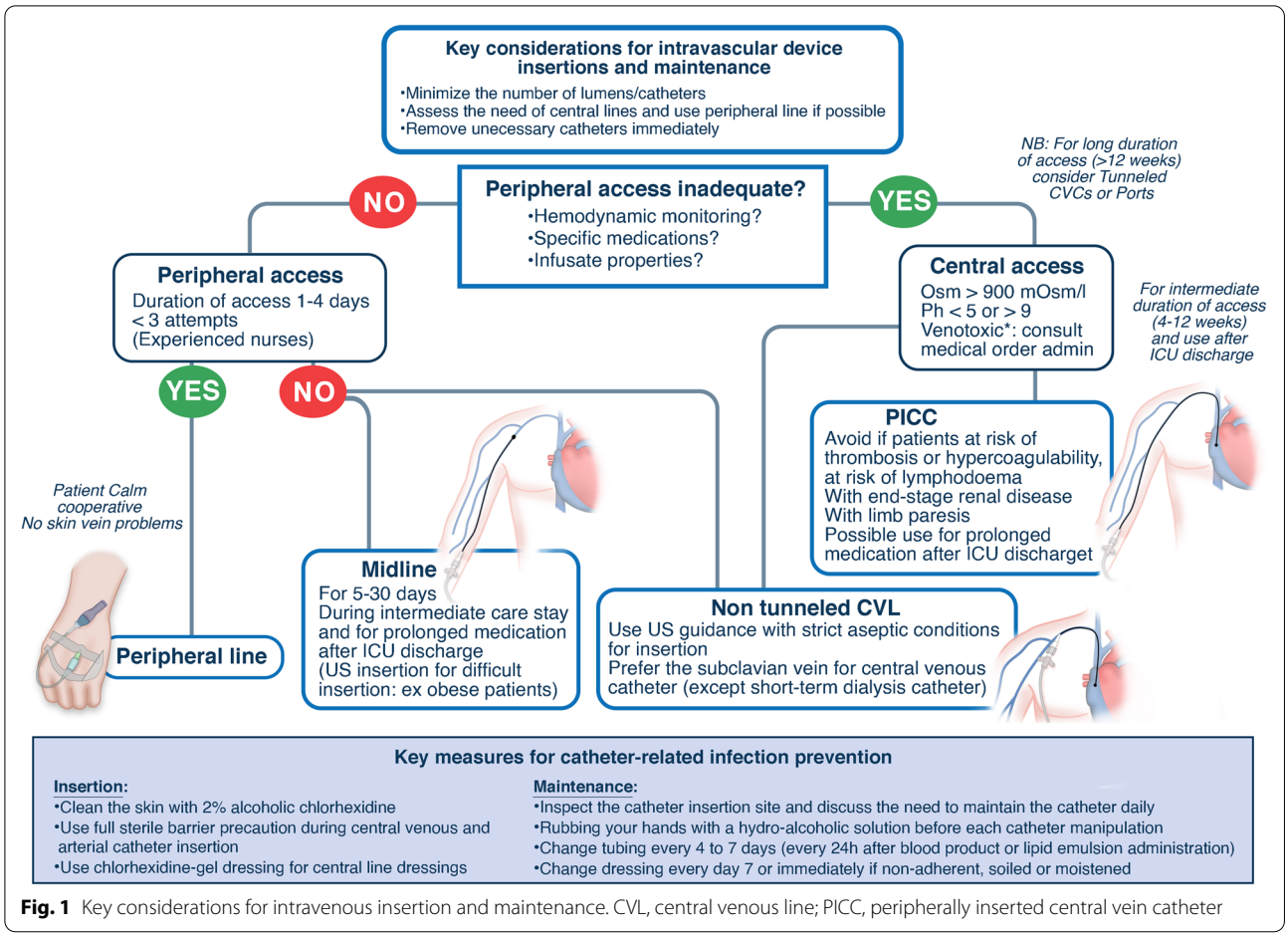

Fig. 1 Key considerations for intravenous insertion and maintenance. CVL, central venous line; PICC, peripherally inserted central vein catheter

The choice of the outcome indicator is difficult. Central line associated bloodstream infection (CLABSI) is defined as a bloodstream infection (BSI) in a patient with a CVL, with no other attributable source of infection. CLABSI overestimates the true infection rate, being inherently subjective because of the need to assign the source of infection. The correlation between CLABSI and catheter colonization or CRBSI is weak. CRBSI requires a positive blood culture and a positive catheter tip culture or a positive differential time to positivity [11]. The use of CRBSI is preferable to assess causality between a BSI and a specific vascular catheter.

Skin disinfection should be performed with 2% alcoholic chlorhexidine, even for peripheral venous accesses [12]. Use of applicators may increase antiseptic diffusion into the deeper layers of the skin while keeping the operator's hands away to reduce the contamination risk, but increases the costs. Conversely, the implementation of universal skin decolonization with chlorhexidine requires further evaluation, given concerns about the potential emergence of chlorhexidine resistance and antibiotic cross-resistance and a substantial risk of cutaneous skin reactions [3, 13]. Other antiseptic solutions such as octenidine have not proven to be effective for ICU patients [3].

More than half of the dressings are replaced due to disruption, which is associated with an increased risk of CRBSI. Transparent semi-permeable dressings allow for continuous observation of the insertion site and should be preferred when there is no bleeding or oozing. They can be safely maintained for up to 7 days but should be changed immediately if they are non-adherent, soiled or moistened. The infusion set should also be changed every 7 days [14]. A new adhesive compound was not able to significantly reduce dressing disruption in ICU [1]. A new acrylic terpolymer skin-protective barrier film around the catheter insertion site resulted in less dressing disruptions and less skin integrity issues but its impact on infectious risk remains to be evaluated. Compared with standard dressings, chlorhexidine dressings reduce the risk of catheter-related infection (CRI) by 60% [3]. Chlorhexidine-gel dressings are easier to apply than chlorhexidine sponge. They allow for visualization of the insertion site and are associated with less dressing disruption but more contact dermatitis [15].

Although effective to decrease CRBSI in ICU, the cost-effectiveness of antimicrobial-coated or impregnated catheters when infection preventive bundles are applied is not established [3]. The use of such catheters should be limited to ICUs having an infection rate above the institutional goals despite their compliance with basic catheter infection prevention practices. Other catheters impregnated with silver zeolite, oligon, platinum, and carbon have been tested but their efficacy has not been proven.

Sutures disrupt the skin at the insertion site and may serve as a nidus for microbial growth. Sutureless devices are safe in ICU in term of CVL migrations and unplanned removal [16]. Hub contamination is common if scrubbing of the catheter hub is not properly done. Needleless connectors are suspected to increase the risk of hub contamination and CLABSI probably mainly because the interface cannot be readily disinfected. Needleless connectors impregnated with silver, associated with decreased rates of CLABSI, have not been sufficiently tested in ICUs [3].

To conclude, most of the times CVL insertion is essential in ICU care but de-escalation to peripheral catheters should be promoted. Midline and PICCS are associated with an important rate of occlusions and thrombosis and expose to a CRBSI risk similar to that of CVL. They might be interesting options when intravenous access should be continued in the intermediate-care unit or in the hospital ward. The role of ultrasound in improving insertion safety is certain but should be accompanied by a strong program for preventing catheters complications.

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Declarations

Conflicts of interest
JFT reported consulting activity for Becton Dickinson and research grant from 3 M and Becton–Dickinson. OM received personal fees, funding for congress and funding from Becton Dickinson, 3 M and Cooper. AT has no conflict of interest to declare.

Publisher's Note

Received: 5 April 2022 Accepted: 26 May 2022
Published: 29 June 2022

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