

## Central venous catheters in neonates: old territory, new frontiers

**Invited commentary to *Peripherally inserted central venous catheters in critically ill premature neonates*, by Ozkiraz et al, J Vasc Access 2013;14(4):320-324**

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The paper presented by Ozkiraz and coworkers in the present issue of our journal (1) raises two interesting questions that are a matter of debate in the field of central venous access in neonates.

The first question relates to the indications and contra-indications of direct central venous access vs. peripherally inserted central access. In the 20th century, direct central venous access in neonates and infants was invariably achieved by open surgical procedures, usually by cannulation of the saphenous vein or of the internal or external jugular veins. This procedure was obviously quite invasive and associated with an increased risk of infection and hemorrhage. On the other hand, many papers of the last few years have suggested that direct central venous access can be safely obtained, even in very small neonates and small infants, by ultrasound-guided (USG) percutaneous puncture and cannulation of the internal jugular vein or of the brachio-cephalic vein, with a high percentage of success and minimal risk (2-6). In a recent study of 45 small infants (mean weight  $2.9 \pm 1.1$  kg) published in this same journal (7), USG central venipuncture was successful in 100%. In another recent series of 34 neonates (mean weight 2.9 kg, range 0.63-4.1 kg), 2.7 Fr central catheters were inserted successfully in 100% (8). In our institution, we usually insert USG central venous catheters in critically ill neonates requiring intensive care management; a recent survey of our experience with 3 Fr and 4 Fr central venous catheters inserted in 47 neonates (age 3 hours to 29 days, weight 0.95-4.2 kg; USG puncture and cannulation of the brachio-cephalic vein) showed a 100% success, with no complications (unpublished data).

The potential advantages of USG direct cannulation of central veins (in neonates, mainly internal jugular vein or brachio-cephalic vein) vs. peripherally inserted central catheters are relevant: by direct central vein cannulation, we can place larger bore polyurethane catheters (2.7 Fr-5 Fr), which can be used for blood sampling, high flow infusion and hemodynamic monitoring (central venous pressure, central venous sampling for oxygen saturation in mixed venous blood, etc.) and which are associated with a very low risk of lumen occlusion or mechanical rupture. Peripherally inserted central catheters (aka "epicutaneous catheters," ECC), when used in neonates, are often

difficult to place even in expert hands (the rate of success in Ozkiraz et al's study was 87.3%) and the position of the tip of the catheter is often not optimal (i.e., not at the cavo-atrial junction); also, the necessity to use small bore silicone or polyurethane catheters (<2.7 Fr) implies the impossibility of blood sampling and a high incidence of lumen occlusion and mechanical rupture (respectively, 30% and 10% in Ozkiraz et al's study).

We think that the exact role of USG central catheters vs. ECC in neonates is still to be defined. Most likely, small weight premature newborns who need just fluid support and parenteral nutrition may benefit from peripherally inserted small bore catheters, while newborns with severe/acute medical or surgical conditions, candidate to surgery or to aggressive intensive care treatments (high-flow infusion, hemodynamic monitoring, hemodiafiltration, i.v. infusion of vasoactive drugs or antibiotics, etc.) should be better treated by placing a USG single lumen (3 Fr-4 Fr) or double lumen (4 Fr-5 Fr) polyurethane central venous catheter.

Another interesting problem raised by Ozkiraz et al's paper deals with some technological novelties which may improve the clinical performance of ECC in neonates, such as the near-infrared (NIR) devices for visualization of the superficial veins and the intracavitary electrocardiograph (ICEKG) method for the successful verification of tip position.

Peripherally inserted catheters (ECC) in neonates are a definitely different vascular access device when compared with peripherally inserted central catheters in children and in adults. In patients over 2-4 years, deep veins of the arm (brachial, basilic, axillary) are usually of a diameter equal to or superior to 3 mm, which allows USG cannulation with 3 Fr catheters (or even larger: up to 6 Fr in some adults), whose tip is easily located in a "central" position (i.e., in proximity to the cavo-atrial junction) and which can be reliably used as a full-performing central venous line (infusion of any type of solution, blood sampling and hemodynamic monitoring).

US has no role in detecting the superficial veins of neonates, so that ECC are usually inserted by direct cannulation of visible/palpable veins of the limbs or of the scalp. In recent times, though, many devices have been developed, which utilize the so-called NIR technology. NIR technology takes advantage of the selective absorption of

a specific wavelength of NIR rays by the desaturated hemoglobin present in the venous system. These devices are designed to use NIR light coupled with advanced technologies which can offer a faithful image of the superficial vasculature (from 0 to 7 mm below the skin surface) directly onto a patient's skin (VeinViewer, Christie Medical; Accuvein, Accuvein Inc.) or on a helmet-based viewer (Veinsite, Vuetek). There is no probe or transducer, so that both the clinician's hands are free to puncture and cannulate the superficial vein. Though the clinical studies in this regard are still quite a few and not always brilliant from the methodological point of view, they are very promising (9-12). It is quite likely that in the future, NIR technology might become the clinical standard for puncture and cannulation of superficial veins, particularly in neonates.

Finally, one of the problems with ECC is the difficulty in placing the tip of the catheter in a correct central position, considering that the use of fluoroscopy is unsafe, expensive and sometimes logistically impossible in the neonatal intensive care unit. The IC-EKG method allows the real-time verification of the proper position of the tip, and its accuracy and cost-effectiveness is demonstrated in adult patients (13, 14). A few old studies about IC-EKG in

infants and neonates already exist in the literature (15-17). Further data will be provided by the forthcoming Italian multicenter study on IC-EKG on children and by one study on IC-EKG in neonates, recently concluded in our institution. We suggest that in the next future both NIR and IC-EKG might be able to improve significantly the success rate and the accuracy of placement of ECC.

Technology—specially if evidence-based—is welcome in any field. Even in the area of neonatal care, which is notoriously very conservative and suspicious of novelties, some technological advances such as US guidance, NIR visualization and IC-EKG may enter the clinical practice and lead to a safer and more effective placement and maintenance of central venous lines.

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