Central venous access in children
State of the art

Mauro Pittiruti
Catholic University, Rome - Italy
Vascular access in pediatrics: a world rapidly changing

The world of pediatric central venous access is rapidly changing, as new methodologies of vein visualization and tip location have dramatically reduced the risks of complications as well as the costs associated with such procedures.
Pediatric Vascular Access Practice: Time for Evolution or Revolution?

By Amanda J Ullman RN, MAppSci, PhD, Centaur Fellow, Director-at-Large; Association for Vascular Access Pediatric Special Interest Group, Senior Lecturer; Alliance for Vascular Access Teaching and Research (AVATAR) Group, Griffith University
1. We need to **improve central venous access in the neonates**, the main issues being:

- Define the role of ultrasound (US) - guided central venous catheters (3Fr, PUR, power injectable, high performance) in premature newborns if compared to the use of epicutaneo-caval catheters (ECC) (1-2.7Fr, silicone or PUR, non-power, low performance)

- Verify the cost-effectiveness and the indication of Near Infra Red Technology in visualizing and cannulating the superficial veins for insertion of ECC

- Improve the training of health care specialists so to implement the use of new technology for insertion (US, NIR) and for tip location (echocardio, intracavitary EKG) of central access in neonates
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2. The world of pediatric central venous access needs an update, by implementing materials and methods which have become (or are becoming) the standard of care in adults:
   - Consistent adoption of US-guidance for all central venous access devices (PICC, CICC, FICC, ports)
   - Adoption of tip location by intracavitary EKG and/or echocardiography
   - Shift to power injectable polyurethane for all external catheters (the reason for still using fragile silicon catheters like Broviac and Hickman is mysterious)
   - Increased use of PICCs as first option central line in all children
   - Increased adoption of tunneling for all external catheters (even if non-cuffed)

3. Eliminate the problem of dislodgment (the main cause of loss of the central line in pediatrics) by an extensive use of subcutaneously anchored securement devices.
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The state of the art

1. Choice of the device
2. Insertion of the device
3. Maintenance of the device
New criteria for the choice of the device

- A new central VAD in neonates and infants
  - Ultrasound-guided CICC
- A new central VAD in children
  - Ultrasound-guided PICC
- No more silicon central VADs
- No more valved central VADs
- The need for an algorithm
New classification of central VADs

Brachio-cephalic, internal jugular, external jugular, subclavian – SUPRACLAVICULAR CVC (**CICC**)

Axillary vein at the chest – INFRACLAVICULAR CVC (**CICC**)

Axillary vein at the arm, basilica, brachial - **PICC**

Saphenous, femoral – INFERIOR VENA CAVA CATH.(**FICC**)
CICC
US guided PICCs

Ideal for
- pediatric intensive care unit
- pediatric surgery (perioperative access)
- pediatric parenteral nutrition
- pediatric oncology/haematology

Which PICCs?:
- non-valved, power injectable polyurethane
**Not to be confused with other peripherally inserted central lines in neonates**

<table>
<thead>
<tr>
<th>Epicutaneo-caval caths</th>
<th>US-guided PICCs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neonates</td>
<td>Infants and children</td>
</tr>
<tr>
<td>Direct or NIR insertion</td>
<td>Ultrasound guidance</td>
</tr>
<tr>
<td>Superficial veins</td>
<td>Deep vein of the arm</td>
</tr>
<tr>
<td>Tip not always central</td>
<td>Tip must be at CAJ</td>
</tr>
<tr>
<td>Caliber &lt; 3Fr</td>
<td>Caliber 3 Fr or &gt;</td>
</tr>
<tr>
<td>Low flow</td>
<td>High flow (power injectable)</td>
</tr>
<tr>
<td>No blood sampling</td>
<td>Ok for blood sampling</td>
</tr>
</tbody>
</table>
Double lumen 5 Fr power injectable PICC in 13 yr old
TABLE I - Summary of AIEOP recommendations

Indications and selection criteria

For long-term treatments, ports should be preferred for intermittent use and cuffed tunneled catheters for frequent/continuous use.

For short- to medium-term treatments, PICCs are a valid option, but they should be inserted only when deep veins of the arm are of appropriate diameter.

There is no evident advantage of silicon vs. polyurethane.

Double-lumen VADs should be used only in selected cases.

Catheters inserted in the femoral vein for medium- to long-term treatments should be tunneled away from the groin.

Valved and nonvalved catheters have the same expected incidence of complications.
PICC vs. CICC

PICC should be preferred whenever possible:
- Less invasive
- Safer (no risk of major complications at insertion)
- Exit site is more favorable
- Can be inserted even in patients with coagulation disorders
- Well tolerated
- The insertion is less expensive
SILICON vs. POLYURETHANE

Silicon has no advantage over polyurethane
- More fragile
- More prone to mechanical damage
- More risk of dislodgment
- More risk of occlusion
- Less performant in terms of flow
- More expensive
Power injectable PUR cuffed catheters today are replacing silicon cuffed catheters
A comprehensive approach to the prevention of central venous catheter complications: results of 10-year prospective surveillance in pediatric hematology-oncology patients

Simone Cesaro¹² · Mara Cavaliere² · Anna Pegoraro¹² · Piergiorgio Gamba³ · Nicola Zadra⁴ · Gloria Tridello¹²

Over a 10-year period, 919 patients (57.3 % males and 42.7 % females) were included in the study. 538 patients (58.5 %) were affected by leukemia or lymphoma, while 381 patients (41.5 %) were affected by solid tumor or non-malignant disease. A total of 1161 newly placed long-term CVCs were inserted for a total of 413,901 CVC-days of observation. The vast majority of CVCs were partially implanted, open-ended, Broviac-Hickman type CVC (95 %). Table 2 lists main patient and CVC characteristics.
complications were managed successfully in most cases and, therefore, were associated with a very low rate of CVC removal (2.3%). Conversely, mechanical complications, affecting 18.3% of CVCs, were associated with the highest premature removal rate (77.4%) and represented 74% of all CVCs removed due to complications (164 of 223). Mechanical complications, classified as dislocation (80%), fracture (16%), kinking (4%), occurred at a median time of 61 days, range 0–818 from insertion. In six cases (3%), these episodes happened early, by 48 h from insertion.

Bacteremia affected 14.8% of CVCs and caused a CVC removal rate of 18.6%. Among the 172 episodes, 107 (62%)...
Valved catheters have no advantage:
- Higher risk of malfunction
- No effect on prevention of occlusion
- More expensive
DAV = Dispositivo per Accesso Venoso (VAD = Venous Access Device)
Exp = Expert system
2018 GAVeCeLT ALGORITHM

Currently available also on Apple Store

Available in Italian – Spanish - English
2018 GAVeCeLT ALGORITHM
Currently available also on Google Play

Available in Italian – Spanish - English
Underlying structure
Underlying structure
Underlying structure

Choice of the venous access device in children

Choice of the venous access device in adults

Choice of the venous access device in the neonate
Choice of the venous access device in children
EMERGENCY ACCESS In children

- In emergency, consider **intraosseous access**

- **20-25%** of children in emergency room are
  
  **DIVA:**
  
  - visualization techniques such as **NIR and US** are necessary
Children - Emergency

No DIVA → Short peripheral cannula ('standard')

DIVA

US-guided peripheral access → Short peripheral cannula Mini-midline

US-guided central access → Non-tunneled CICC Non-tunneled FICC

Intraosseous access
US-guided mini-midline
Ultrasound-guided placement of long peripheral cannulas in children over the age of 10 years admitted to the emergency department: a pilot study

Angela Paladini,¹ Antonio Chiaretti,¹ Kidane Wolde Sellasie,² Mauro Pittiruti,³ Giovanni Vento¹
US-guided non-tunneled FICC
Children - Elective
Intra-hospital use

Peripheral access is appropriate

- **< 48 hrs**
  - No-DIVA → short peripheral cannula ('standard')
  - DIVA → US-guided long peripheral cannula (mini-midline)

- **2-7 days**
  - No-DIVA → short peripheral cannula ('advanced')
  - DIVA → US-guided long peripheral cannula (mini-midline)

- **>7 days**
  - US-guided long peripheral cannula (mini-midline)

Central access is required

- Arm veins available (green zone) → non-tunneled PICC
- Arm veins available (only in yellow zone) → tunneled PICC
- Arm veins not available → CICC (tunneled or not)
Non-tunneled PICC
Tunneled CICC
Tunneled FICC
Children - Elective
Extra-hospital use

<4-6 months
- Peripheral access is appropriate
  - mini-midline or midline
- Central access is required
  - Arm veins available: non-cuffed PICC, tunneled or not
  - Arm veins not available: non-cuffed, tunneled CICC

>4-6 months
- CVC (PICC, CICC o FICC), tunneled + SAS
- CVC (PICC, CICC o FICC), cuffed-tunneled
- PICC-port or chest-port
Tunnelled CICC + SAS

Better than the cuff:
- Immediately effective
- Easier removal of the CICC
- Less expensive
Choice of the venous access device in the neonate
Neonate
Venous access needed at birth

No indication to UVC
Peripheral venous access
Peripheral venous access
Short peripheral cannula

Indication to UVC
Single or double lumen UVC for 7 days or less

After 7 days
Stable conditions
Critically ill
US-guided CICC or FICC

< 7 days: short peripheral cannula
7-14 days: epicutaneo-caval catheter (ECC)
> 14 days: US-guided CICC or FICC
Epicutaneo-caval catheters in neonates: New insights and new suggestions from the recent literature

Giovanni Barone and Mauro Pittiruti
CICC
(brachio-cephalic vein)
Neonate
Venous access needed > 24 hrs after birth

Stable conditions, not preterm
< 7 days : short peripheral cannula
> 7 days : epicutaneo-caval catheter

Stable conditions, preterm
< 7 days : short peripheral cannula
7-14 days : epicutaneo-caval catheter
> 14 days : US-guided CICC or FICC

Critically ill
US-guided CICC or FICC
Proper choice of the vein

- Scan of superficial veins
  - RaSuVA in neonates
- Scan of deep veins
  - RaCeVA, RaPeVa, RaFeVA
- Vein/catheter ratio
<table>
<thead>
<tr>
<th>RaSuVA</th>
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<tbody>
<tr>
<td>RaSuVA</td>
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<table>
<thead>
<tr>
<th>Malleolo mediale (MM)</th>
<th>Vd</th>
<th>Fd</th>
<th>Vs</th>
<th>Fs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malleolo laterale (ML)</td>
<td>Vd</td>
<td>Fd</td>
<td>Vs</td>
<td>Fs</td>
</tr>
<tr>
<td>Retropoplitea (RP)</td>
<td>Vd</td>
<td>Fd</td>
<td>Vs</td>
<td>Fs</td>
</tr>
<tr>
<td>Mano e polso (MP)</td>
<td>Vd</td>
<td>Fd</td>
<td>Vs</td>
<td>Fs</td>
</tr>
<tr>
<td>Antecubitale (AC)</td>
<td>Vd</td>
<td>Fd</td>
<td>Vs</td>
<td>Fs</td>
</tr>
<tr>
<td>Preauricolare (PR)</td>
<td>Vd</td>
<td>Fd</td>
<td>Vs</td>
<td>Fs</td>
</tr>
<tr>
<td>Postauricolare (PO)</td>
<td>Vd</td>
<td>Fd</td>
<td>Vs</td>
<td>Fs</td>
</tr>
</tbody>
</table>
Scan of deep veins

- PICC – RaPeVA
- CICC – RaCeVA
- FICC – RaFeVA
Rapid Central Vein Assessment (RaCeVA): A systematic, standardized approach for ultrasound assessment before central venous catheterization

Timothy R Spencer¹ and Mauro Pittiruti²
There is no ideal site for cannulation in children; the best site should be determined after ultrasound examination.

RaCeVA – Rapid Central Vein Assessment
RaCeVA in 4 mo. old in PICU
The choice: BCV
Diameter of the veins!
Diameter of the veins !
A Systematic Ultrasound Evaluation of the Diameter of Deep Veins in the Newborn: Results and Implications for Clinical Practice

Giovanni Barone\textsuperscript{a} Vito D’Andrea\textsuperscript{a} Giovanni Vento\textsuperscript{a} Mauro Pittiruti\textsuperscript{b}

\textsuperscript{a} Neonatal Intensive Care Unit, Fondazione Policlinico A. Gemelli IRCCS, Rome, Italy; \textsuperscript{b} Department of Surgery, Fondazione Policlinico A. Gemelli IRCCS, Rome, Italy
Diameter of the veins !
New insertion techniques

• Puncture/cannulation of superficial veins
  – Near Infra Red technology

• Puncture/cannulation of deep veins
  – No more venous cutdown
  – No more ‘blind’ puncture
  – Real time ultrasound guidance
  – Micro-introducer kits

• New methods of tip navigation and tip location
  – No more fluoroscopy
  – IC-ECG and echocardiography
Central lines in neonates, infants and children

Umbelical – DIRECT INSERTION
Epicutaneo-caval caths – NIR TECHNOLOGY
CICC, PICCs, etc. ULTRASOUND GUIDANCE
NIR TECHNOLOGY
NIR in children
NIR TECHNOLOGY

Ideal for detection – puncture – cannulation of superficial veins (< 7mm of depth)

doi:10.1093/bja/aet078

EDITORIAL II

Difficult peripheral veins: turn on the lights

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² Department of Surgery, Catholic University, Rome, Italy
* Corresponding author. E-mail: doclampmd@gmail.com
ULTRASOUND

Ideal (mandatory !) for detection – puncture – cannulation of deep veins (> 7mm of depth)
Ultrasound Guided Central Vascular Access in Neonates, Infants and Children

Mauro Pittiruti*

Department of Surgery, Catholic University, Largo Francesco Vito 1, 00168 Roma, Italy


Mauro Pittiruti

Table 1. Central Lines

<table>
<thead>
<tr>
<th>Type of Catheter</th>
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<tbody>
<tr>
<td>Umbilical catheters (Umbilical vein)*</td>
</tr>
<tr>
<td>Epicutaneo-caval catheters (Superficial veins of limbs or scalp)*</td>
</tr>
<tr>
<td>Central venous catheters: tunneled, non-tunneled, ports (central veins of the neck and of the supra/infra-clavicular region)</td>
</tr>
<tr>
<td>PICC, Peripherally Inserted Central Catheters (Deep veins of the arm)</td>
</tr>
<tr>
<td>Inferior Vena Cava catheters (femoral and saphenous vein)</td>
</tr>
</tbody>
</table>

* = only in neonates.
International evidence-based recommendations on ultrasound-guided vascular access
US guided venipuncture

Always keep an eye on the tip of the needle
International evidence-based recommendations on ultrasound-guided vascular access
Micro-introducer kits
Ultrasound for tip navigation
Tip navigation by US

- US is not just for puncture!

- US control of the direction of guidewire and/or catheter (tip navigation by US) is particularly easy in neonates and infants

- Tip navigation by US should be implemented also in UVC and ECC!!
IC-ECG for tip location
IC-EKG method

- Intracavitary ECG (lead II)
- The intracavitary electrode is the tip of the catheter
- Based on changes of P wave during the progression of the catheter into the central veins
- CAVO-ATRIAL JUNCTION: maximal peak of the P wave (Stas, Yeon, Schummer, Pittiruti/La Greca, etc.)
  (= CRISTA TERMINALIS)
P increasing
Maximal P
P decreasing and/or diphasic
The intracavitary ECG method for positioning the tip of central venous access devices in pediatric patients: results of an Italian multicenter study

Francesca Rossetti¹, Mauro Pittiruti², Massimo Lamperti³, Ugo Graziano⁴, Davide Celentano⁵, Giuseppe Capozzoli⁶

¹ Department of Anesthesia, Children’s Hospital ‘Meyer’, Firenze - Italy
² Department of Surgery, Catholic University Hospital, Roma - Italy
³ Department of Neuroanesthesia, Neurological Institute ‘Busta’, Milano - Italy
⁴ Department of Surgery, Children’s Hospital ‘Santobono’, Napoli - Italy
⁵ Pediatric Intensive Care Unit, Catholic University Hospital, Roma - Italy
⁶ Department of Anesthesia and Intensive Care, Ospedale Civile di Bolzano, Bolzano - Italy
Applicability

99.4 %

- In 2 children out of 309, the P wave was not identified on the surface ECG, so that IC-ECG was not performed
  - One child 2 mo. old
  - One child 5 yr old
Feasibility

99.4 %

– In 2 cases out of 307 no elevation of the P wave could be identified:
  • One child 1 mo. old
  • One child 2 yr old
Accuracy

95.8%
- Gr. A 96.2%
- Gr. B 95%
- Gr. C 96.8%

In all cases of mismatch but one, tip position as estimated with IC-EKG was too low as estimated by radiological criteria (from +1cm to +5cm).

In the 95 cases performed with a dedicated ECG monitor (Nautilus) accuracy was 98.8%
Safety

100%

• No complication directly or indirectly related to the IC-EKG method
The intracavitary electrocardiography method for tip location of jugular internal vein access device in infants of less than 5 kg: A pilot study

Rossella Mastroianni, Antonella Capasso and Gaetano Ausanio
The intracavitary electrocardiography method for positioning the tip of epicutaneous cava catheter in neonates: Pilot study

Antonella Capasso¹, Rossella Mastroianni¹, Annalisa Passariello²,³, Marta Palma², Francesco Messina⁴, Antonella Ansalone¹, Italo Bernardo¹, Daniela Brescia¹, Francesco Crispino¹, Carolina Grassia¹, Attilio Romano¹ and Gaetano Ausanio¹
AHRQ recommendations

Annals of Internal Medicine

The Top Patient Safety Strategies That Can Be Encouraged for Adoption Now

Paul G. Shekelle, MD, PhD; Peter J. Pronovost, MD, PhD; Robert M. Wachter, MD; Kathryn M. McDonald, MM; Karen Schoelles, MD, SM; Sydney M. Dy, MD, MSc; Kaveh Shojania, MD; James T. Reston, PhD, MPH; Alyce S. Adams, PhD; Peter B. Angood, MD; David W. Bates, MD, MSc; Leonard Bickman, PhD; Pascale Carayon, PhD; Sir Liam Donaldson, MBChB, MSc, MD; Naihua Duan, PhD; Donna O. Farley, PhD, MPH; Trisha Greenhalgh, BM BCH; John L. Haughom, MD; Eileen Lake, PhD, RN; Richard Lliford, PhD; Kathleen N. Lohr, PhD, MA, MPH; Gregg S. Meyer, MD, MSc; Marlene R. Miller, MD, MSc; Duncan V. Neuhauser, PhD, MBA, MHA; Gery Ryan, PhD; Sanjay Saint, MD, MPH; Stephen M. Shortell, PhD, MPH, MBA; David P. Stevens, MD; and Kieran Walsh, PhD
<table>
<thead>
<tr>
<th>Table 2. Patient Safety Strategies Ready for Adoption Now</th>
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</table>

**Strongly encouraged**
- Preoperative checklists and anesthesia checklists to prevent operative and postoperative events
- Bundles that include checklists to prevent central line–associated bloodstream infections
- Interventions to reduce urinary catheter use, including catheter reminders, stop orders, or nurse-initiated removal protocols
- Bundles that include head-of-bed elevation, sedation vacations, oral care with chlorhexidine, and subglottic suctioning endotracheal tubes to prevent ventilator-associated pneumonia
- Hand hygiene
- The do-not-use list for hazardous abbreviations
- Multicomponent interventions to reduce pressure ulcers
- Barrier precautions to prevent health care–associated infections
- **Use of real-time ultrasonography for central line placement**
- Interventions to improve prophylaxis for venous thromboembolisms
Encouraged
- Multicomponent interventions to reduce falls
- Use of clinical pharmacists to reduce adverse drug events
- Documentation of patient preferences for life-sustaining treatment
- Obtaining informed consent to improve patients’ understanding of the potential risks of procedures
- Team training
- Medication reconciliation
- **Practices to reduce radiation exposure from fluoroscopy and CT**
- The use of surgical outcome measurements and report cards, such as those from ACS NSQIP
- Rapid-response systems
- Use of complementary methods for detecting adverse events or medical errors to monitor for patient safety problems
- Computerized provider order entry
- Use of simulation exercises in patient safety efforts
Use methods for identifying CVAD tip location during the insertion procedure (ie, “real time”) due to greater accuracy, more rapid initiation of infusion therapy, and reduced costs.

1. Use electrocardiogram (ECG) methods with either a metal guidewire or a column of normal saline inside the catheter lumen and observe the ECG tracing to place the CVAD tip at the CAJ. Follow manufacturers’ directions for use with other ECG-based technology using a changing light pattern to detect tip location.
Avoid fluoroscopy except in the case of difficult CVAD insertions, as it requires exposure to ionizing radiation. Postprocedure radiograph imaging is not necessary if alternative tip location technology confirms proper tip placement.
Confirmation of tip location by postprocedure chest radiograph remains acceptable practice and is required in the absence of technology used during the procedure. This method is less accurate because the CAJ cannot be seen on the radiograph, requiring identification of tip location by measurement from the carina, trachea-bronchial angle, or thoracic vertebral bodies. Additionally, a change in the patient position from supine to standing, usually required for the radiograph, results in movement of the catheter tip by as much as 2 cm. \(^3,11,12,19,20\) (II)
In the pediatric patient, the correct position of the tip can also be verified by echocardiography (TTE)
Tip location by echocardiography (TTE)

TTE : trans-thoracic echocardiography

• Accuracy depending on the method used and on the operator
• Widely used in Europe more than in USA
• Ideal in neonates and children
• May be difficult in some adult patients
TTE for tip location: does it work?

**Apical four chamber view**

- Easy to perform
- Visualization of the tip only if it is inside the right atrium
- Indirect visualization by CEUS (evidence of contrast flow within 1-2 sec after injection = tip is in the lower 1/3 of SVC)
TTE for tip location: does it work?

Subcostal ‘bi-caval’ view

- Requires training
- Direct visualization of the tip in RA, SVC or IVC
- May be difficult or impossible in some conditions (obesity, COPD, abdominal surgery)
International evidence-based recommendations on ultrasound-guided vascular access
Table 4 Recommendations on ultrasound vascular access in adults and cost-effectiveness

<table>
<thead>
<tr>
<th>Domain code</th>
<th>Suggested definition</th>
<th>Level of evidence</th>
<th>Degree of consensus</th>
<th>Strength of recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>D4.SD2.S1</td>
<td>Ultrasound guidance should be routinely used for short-term central venous access in adults</td>
<td>A</td>
<td>Very good</td>
<td>Strong</td>
</tr>
<tr>
<td>D4.SD2.S2</td>
<td>Ultrasound guidance should be routinely used for long-term central venous access in adults</td>
<td>A</td>
<td>Very good</td>
<td>Strong</td>
</tr>
<tr>
<td>D4.SD2.S3</td>
<td>PICCs should be routinely inserted at mid arm level by ultrasound guidance using micro introducer technique</td>
<td>A</td>
<td>Very good</td>
<td>Strong</td>
</tr>
<tr>
<td>D4.SD2.S4</td>
<td>Use of ultrasound guidance should be taken into consideration for any kind of peripheral intravenous line when difficult access is anticipated</td>
<td>B</td>
<td>Very good</td>
<td>Strong</td>
</tr>
<tr>
<td>D4.SD2.S5</td>
<td>Ultrasound-guided arterial catheterization improves first-pass success and should be used routinely in adults</td>
<td>A</td>
<td>Very good</td>
<td>Strong</td>
</tr>
<tr>
<td>D4.SD2.S6</td>
<td>Ultrasound can accurately detect pneumothorax and should be routinely performed after central venous catheter cannulation when the pleura could have been damaged</td>
<td>B</td>
<td>Very good</td>
<td>Strong</td>
</tr>
<tr>
<td>D4.SD2.S7</td>
<td>CEUS (contrast-enhanced ultrasound) is a valid method for detecting a central venous catheter tip in the right atrium</td>
<td>B</td>
<td>Very good</td>
<td>Strong</td>
</tr>
<tr>
<td>D5.S1–3</td>
<td>Ultrasound-guided vascular access has to be used because it results in clinical benefits and reduced overall costs of care and makes it cost-effective</td>
<td>A</td>
<td>Very good</td>
<td>Strong</td>
</tr>
</tbody>
</table>
TTE = best choice in neonates
The ECHO-TIP protocol

• Tip navigation and Tip location in neonates
  – Linear probe for tip navigation
  – Microconvex or microsectorial probe for tip location

• Tip navigation and Tip location in children
  – Linear or microconvex probe for tip navigation
  – Microconvex probe for tip location
The importance of the exit site

- The role of tunneling
- ‘Secure & Protect’
  - Securement
    - Sutureless securement
    - Cyanoacrilate glue
    - Transparent semipermeable membranes with high MVTR
  - Protection
    - Skin antisepsis with 2% chlorhexidine
    - Cyanoacrilate glue
    - Transparent semipermeable membranes with high MVTR
Tunneling
Tunneled CICC in a child
Tunneled CICC in neonate
How to tunnel?
Ideal securement
Sutureless devices

- Subcutaneous anchorage
Clinical experience of a subcutaneously anchored sutureless system for securing central venous catheters

Mauro Pittiruti, Giancarlo Scoppettuolo, Laura Dolcetti, Davide Celentano, Alessandro Emoli, Bruno Marche and Andrea Musarò

ABSTRACT
This article reports the results of three prospective clinical studies conducted in a university hospital regarding the efficacy, safety and cost-effectiveness of a subcutaneously anchored sutureless system for securing central venous catheters. The results were favourable to the adoption of such a device, and the analysis of the data allowed the authors to define those categories of patients where the device should have the most benefit: neonates, children, non-compliant older patients with cognitive difficulties, patients with skin abnormalities that may reduce the effectiveness of a skin-adhesive sutureless securement system, patients who are candidates for having a peripherally inserted central catheter (PICC) in place for more than 8 weeks, and any other category of patients with a recognised high risk of catheter dislodgement.

Key words: Sutureless securement □ Central venous catheters □ Peripherally inserted central catheter □ Subcutaneously anchored securement □ Stabilisation device
Glue !!!!
Comments

**Glue** is a simple, safe, inexpensive tool for closing the skin at the puncture site and sealing the skin around the catheter at the exit site.

- Stops extraluminal contamination
- Stops bleeding/oozing at the exit site
- Secures the catheter for 7-10 days
Use of glue should be implemented also in ECC
Targeting zero catheter-related bloodstream infections in pediatric intensive care unit: a retrospective matched case-control study

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The past
The present
Please, avoid sutures....
Please, avoid sutures....
New protocols of maintenance

• ‘Secure & Protect’
  – Skin antisepsis with 2% chlorhexidine
  – Transparent semipermeable membranes with high MVTR
  – Chlorhexidine-releasing sponge dressing
• No more heparin lock!
• New strategies to prevent intraluminal contamination
  – Passive disinfection of the hubs (port protectors)
  – Non-antibiotic antimicrobial locks
F. Perform a vigorous mechanical scrub for manual disinfection of the needleless connector prior to each VAD access and allow it to dry.

1. Acceptable disinfecting agents include 70% isopropyl alcohol, iodosphors (ie, povidone-iodine), or >0.5% chlorhexidine in alcohol solution.\(^7,16\) (II)

G. Use of passive disinfection caps containing disinfecting agents (eg, isopropyl alcohol) has been shown to reduce intraluminal microbial contamination and reduce the rates of central line-associated bloodstream infection (CLABSI). Use of disinfection caps on peripheral catheters has limited evidence but should be considered.
Use port protectors!
A comprehensive approach to the prevention of central venous catheter complications: results of 10-year prospective surveillance in pediatric hematology-oncology patients

Simone Cesaro¹,² · Mara Cavaliere³ · Anna Pegoraro¹,² · Piergiorgio Gamba³ · Nicola Zadora⁴ · Gloria Tridello¹,²

...cutaneous technique. From January 2005, both techniques were modified by introducing the Sri Paran method to improve the fixation of the CVC to the chest wall [12] while the blind percutaneous venipuncture (landmark venipuncture) was carried out even earlier, from 2007.

...week [9]. The skin care at CVC exit remained constant for the whole study period and consisted of weekly cleansing of the CVC exit-site with a 10% povidone-iodine solution followed by covering with a sterile gauze dressing. Moreover, strict aseptic techniques and scrupulous hand hygiene were observed always in positioning and handling the CVC. Table 1...
pened early, by 48 h from insertion.

Bacteremia affected 14.8% of CVCs and caused a CVC removal rate of 18.6%. Among the 172 episodes, 107 (62%) were caused by Gram positive, 49 (28%) were caused by Gram negative, two (1%) were polymicrobial Gram positive/Gram negative and twelve (7%) were fungemias, unknown in two cases. These episodes occurred at a median time of 98 days, range 0–1297, from insertion of CVC. Among the Gram positive bacteria, the most frequent strain was *Staphylococcus epidermidis* and among the Gram negative bacteria, the most frequent strain was *Escherichia coli*. The list of all bacteria cultured from the blood is shown in Table 4.

Exit-site/tunnel infection affected 11.5% of CVCs and resulted in a removal rate of 9.7%. There were 134 episodes of exit-site infection which were diagnosed at a median time from CVC insertion of 62 days, range 2–640. According to our score, they were classified as grade 1 in 38 episodes, grade 2 in 52 episodes and grade 3 in 44 episodes.
Evidence-based criteria for the choice and the clinical use of the most appropriate lock solutions for central venous catheters (excluding dialysis catheters): a GAVeCeLT consensus

Mauro Pittiruti, Sergio Bertoglio, Giancarlo Scoppettuolo, Roberto Biffi, Massimo Lamperti, Alberto Dal Molin, Nicola Panocchia, Nicola Petrosillo, Mario Venditti, Carla Rigo, Enrico Delutio
No more heparin lock!

INS 2016: Anticoagulant lock

- In all peripheral and central VADs not used for dialysis or apheresis, in all patients:
  - No evidence of difference between saline lock and heparin lock
- In VADs used for apheresis:
  - Lock with heparin 100 units/ml or 4% citrate
- In VADs used for dialysis:
  - Lock with heparin 1000 units/ml or 4% citrate
A comprehensive approach to the prevention of central venous catheter complications: results of 10-year prospective surveillance in pediatric hematology-oncology patients

Simone Cesaro¹,² · Mara Cavaliere² · Anna Pegoraro¹,² · Piergiorgio Gamba³ · Nicola Zadra⁴ · Gloria Tridello¹,²

CVC maintenance care was handled by trained pediatric nurses and consisted of flushing the CVC with 3 mL of normal solution and heparin 200 IU/mL twice a week by using a standard CVC cap. This procedure differed only in 101 patients who constituted the experimental arm of a randomized controlled trial.
of complication, their incidence, and the removal rate. The incidence of complications ranged from 0.5% for pneumothorax to 42% for malfunction/occlusion, respectively. The malfunction/occlusion episodes were 488 and occurred at a median time of 75 days from insertion of CVC, range 0–1303. They were classified as malfunction for the difficulty to withdraw blood or infuse solutions through the CVC in 292 episodes (60%) and as complete CVC occlusion in 192 episodes (39%). In four cases, the type of malfunction was not reported. Despite their high frequency, malfunction/occlusion complications were managed successfully in most cases and,
CONCLUSION
ZERO COMPLICATIONS is possible

If we only want it

If we make the ‘right’ choices in terms of methodologies and materials
Who is the ‘expert’?
Who is the expert?

• The expert is the clinician able to choose (a) the most appropriate methodology, and (b) the most appropriate materials.

• Appropriate = associated with the highest safety and highest cost-effectiveness
Who is the expert?

Who is the expert in wines and spirits?
Who is the expert?

It is a question of QUALITY, not of QUANTITY.
Who is the expert?

Wise choice of methodologies:
- ultrasound guidance for venipuncture
- micro-introducer kits for venipuncture
- tunneling for achieving an ideal exit site
- intracavitary ECG for tip location
- ultrasound for tip navigation
- ultrasound for r/o pneumothorax
Who is the expert?

Wise choice of the materials:
- catheters
- needles, guidewires, introducer sheath, etc.
- ultrasound device, type of probe, etc.
- ECG monitor, ECG cables, etc.
- sutureless device, dressing, etc.

..................
Health care professionals love progress, but they hate changes
(Ken Symington)

When you are still doing a medical procedure exactly the way you used to do it 20 years ago, something is going wrong
(Jack LeDonne)
6th World Congress on Vascular Access

17-19 June 2020

Megaron Athens Greece