Vascular access in the ICU

Understanding the role of PICCs in the critical care setting

BD

Meeting critical patient needs

Selecting an appropriate vascular access device (VAD) in the intensive care unit (ICU) is complex, meriting careful examination of infusion needs and other considerations.

Infusion needs

In the ICU, critically ill patients often require central venous access with a range of performance requirements, including:

- Rapid intravenous infusion of fluids for rehydration purposes[1]
- Intravenous infusion of drugs and solutions that are vesicants, irritants, and/or are hyperosmolic[1]
- Administration of parenteral nutrition[1]
- Need for repeated blood sampling[1]
- Hemodynamic monitoring[1]

Other considerations

When selecting central venous access, consider these factors:

- Patient diagnosis and comorbidities[1]
- Potential complications during placement and removal[1]
- Recommended patient positioning[1]
- Projected time in the ICU[1]
- Anticipation of post-ICU therapy[1]

Catheters in the ICU: PICCs, FICCs, and CICCs

In the ICU, there are a variety of catheter options to meet critical patient needs. Carefully consider which may be best for each situation.

	Power injectable PICCs	Centrally Inserted Central Catheters (CICCs)	Upper Groin Femorally Inserted Central Catheters (FICCs)
Terminate in a central vein	✓[2]	✓[3]	✓[4]
Deliver incompatible infusates via multi-lumen catheter	✓[5]	✓[3]	✓[6]
Allow for blood draw	✓[2]	✓[3]	✓[7]
Pressure-injectable for use with CT scans	✓[2]	✓[8]	✓[8]
Compatible with CVP monitoring	✓[2]	✓[3]	✓[7]
Recommended for long-term use	✓[2]	✗[3]	✗[7]
Recommended use beyond 48 hours	✓[2]	✓[8]	✗[7]
Can be placed and removed while patient is slightly elevated	✓[9]	✗[3]	✓[10]
No risk of carotid, subclavian, or femoral artery puncture during insertion	✓[11]	✗[11]	✗[11]
No risk of iatrogenic pneumothorax	✓[2]	✗[12]	✓[13]
No risk of iatrogenic hemothorax	✓[2]	✗[14]	✓[6]
Removal does not require supine or Trendelenburg	✓[2]	✗[3]	✓[15]
Accommodates flow rates for rapid resuscitation	✗	✓[16]	✓[6]

Advantages of placing PICCs in the ICU

- Central access for high-acuity complex cases such as collars, burns, halos[2]
- No risk of iatrogenic pneumothorax and iatrogenic hemothorax[2]
- Reduced risk of bleeding during placement compared to other central lines[17]
- Microbial load demonstrated to be lower in peripheral insertion sites in comparison to neck and chest[18]
- More options for patient positioning during insertion and removal[2,9]
- Reduced need for confirmatory X-ray with tip confirmation technology compared to blind placement[19]
- Can be used for short- and long-term vascular access[2]

Clinical advantages of placing PICCs in the ICU

PICCs can provide central access for higher-acuity patient scenarios

When a patient enters the ICU, consider the patient's condition, potential for long-term treatment, and overall health and comfort.

Examples of conditions favoring PICCs:[24]

- Anatomical (helmets, halo brace, collars)
- Coagulopathies (clotting disorders, anticoagulant drugs)
- Severe pulmonary conditions (respiratory failure, included COVID-19 pneumonia)
- Tracheostomy
- Elevated risk of pleuropulmonary complications
- Burns or infected skin in the chest/neck area
- Obesity

PICCs carry no risk of iatrogenic pneumothorax and hemothorax[2]

When selecting an insertion site for central venous access, carefully consider the risks of insertion location. There are several life-threatening CICC insertion-related risks that are not associated with PICCs.[14,20]

Iatrogenic Pneumothorax

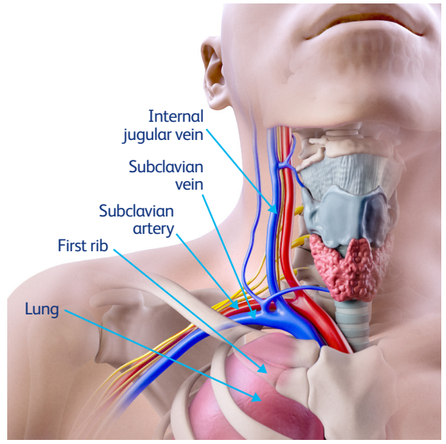
An iatrogenic pneumothorax is an unexpected hospital-acquired condition where there is the presence of air or gas in the cavity between the lungs and the chest wall, causing collapse of the lung.[21]

Iatrogenic Hemothorax

An iatrogenic hemothorax is an unexpected hospital-acquired condition where blood collects in the space between the chest wall and the lung (the pleural cavity).[22]

Rates for image-guided central venous access

Insertion Site Location	Iatrogenic Pneumothorax	Iatrogenic Hemothorax
Subclavian	2%-3%[23]	1%[23]
Jugular	1%[23]	1%[23]
FICC	0%[23]	0%[23]
PICC	0%[23]	0%[23]



The risk of pneumothorax and hemothorax when using CICCs is low; however, it is still present.[23]

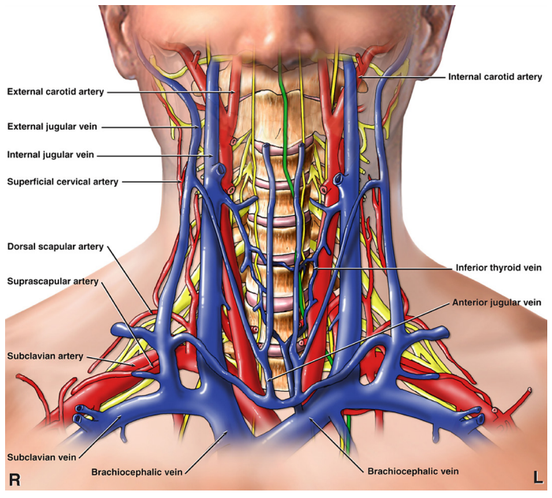
Iatrogenic pneumothorax and hemothorax is associated with subclavian and jugular catheter insertions.[12,23] For patients with lung conditions—such as pulmonary conditions, lung cancer, and/or pneumonia—it's important to minimize the risk of additional complications (like iatrogenic pneumothorax and/or hemothorax) as compromised respiratory systems are at play before insertion risks are introduced. A PICC may provide the least amount of risk of adverse complications of iatrogenic pneumothorax and hemothorax during insertion.[12,24]

PICCs are associated with reduced risk of major arterial puncture compared to other central lines

It is worth considering the arteries near various catheters insertion sites and the patient's risk of bleeding (coagulopathy).

Consider this:

Vessels commonly utilized for insertion sites of CICCs, PICCs, and FICCs	Vessels in close proximity
Internal jugular vein[27]	Carotid artery[27]
Subclavian vein[27]	Subclavian artery[27]
Femoral vein[27]	Femoral artery[28]
Brachial vein[29]	Brachial artery[29]
Basilic vein[28]	Brachial artery[28]



Consider the Guidelines on Coagulopathy

According to the Society of Interventional Radiology (SIR) and endorsed by the Cardiovascular and Interventional Radiological Society of Europe (CIRSE), PICCs have a "lower risk of bleeding, being more easily detectable and controllable."[17] This is a Category 1 recommendation.

Researchers have additionally noted that "arterial access in the periphery is easily managed with digital compression-promoting coagulation."[30]

While ultrasound is a widely available tool that can aid in proper catheter placement, researchers have also noted that the use of ultrasound does not eliminate the risk of internal jugular arterial puncture.[27,31]

Chest and neck have a higher colonization rate than peripheral access sites[32]

Did you know?

According to the ESCAPE* study, **microbial load** at the **catheter site impacts risk** of increased colonization during

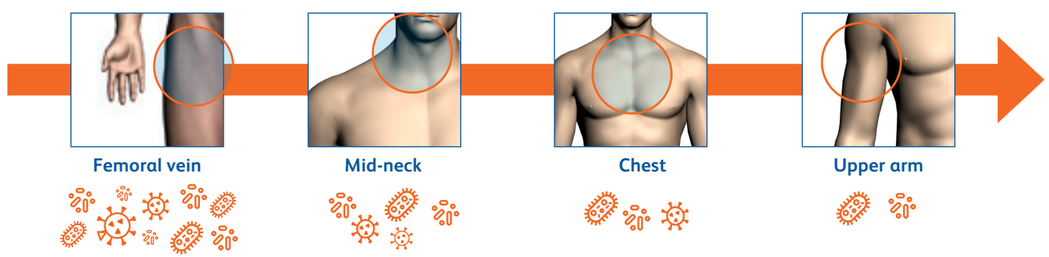
- Insertion of vascular access devices (VAD)[18]
- Long-term dwell of the device[18]

Also that **site selection**

- May have an important role in preventing a potential harmful infection[18]

*Evaluation of skin colonization and placement of vascular access device exit sites—a study to determine if presence of varying levels of microorganisms on the skin had an effect on vascular access device (VAD) site selection.[18]

The relationship of microbial load on skin at vascular access insertion site



Higher microbial load
Femoral and internal jugular access sites are associated with increased risk of central line-associated bloodstream infection (CLABSI)[32] because they have a higher microbial load on the skin during and after device placement

Lowest microbial load
was found in the upper arm in the largest percent of population of patients in the ICU[18]

Know the risks: tracheostomies and infection

When a patient has a tracheostomy, they may be at higher risk for central line infection.[33] It's recommended to stay far away from the jugular site when placing a central line; therefore, a PICC may be a more appropriate choice in this scenario.

Site selection—The American Society of Anesthesiologists recommends selecting a catheter insertion site that is not contaminated or potentially contaminated (i.e. adjacent to a tracheostomy).[33]

Risk—The Society for Healthcare Epidemiology of America states that patients who have a tracheostomy concurrent with a jugular site catheter placement may be at higher risk for infection.[34]

PICCs offer more options for patient positioning during insertion and removal

Patient positioning for placement and removal of central lines			
	CICCs	FICCs	PICCs
Trendelenburg	✓ [35]	⊗	⊗
Prone	⊗	⊗	✓ [36]
Supine	✓*	✓ [6]	✓ [9]
Semi-Fowlers	⊗	✓ [7]	✓ [9]

*Trendelenburg recommended for CICC placement and removal by the Joint Commission; supine if necessary

Consider this:

For placement

According to recent studies,[37] it's been shown that **PICCs** can be inserted while the patient is sitting up.

CICCs can only be inserted when the patient is in Trendelenburg, or supine if necessary,[35] according to the Joint Commission.

For removal

PICCs No published cases of air embolism associated with PICC removal have been reported[15]

CICCs & FICCs **30 mins**

INS guidelines recommend that **patient should be flat for 30 mins** to reduce air embolism and bleeding risk after removal of **CICC** and **FICC**.[15]

** Gruppo Accessi Venosi Centrali Alungo Termine

PICCs can be placed at the bedside with navigation and tip confirmation[38]

The Infusion Nurses Society recommends to "position the tip of a CVAD in the lower third of the superior vena cava (SVC) at or near the cavoatrial junction (CAJ) for adults and children".[15] With both **bedside navigation and tip confirmation technology, PICCs can help with first-attempt success rates and correct tip positioning**[19] — so you can confidently place the catheter and help optimize patient comfort.

Procedural placement technology support	BD power injectable PICCs[2]	CICC[39]	FICC[40]
Able to be placed with navigation systems	✓	✓*	✓*
Usable with tip confirmation systems	✓	✓*	✓*
Able to be inserted with ultrasound	✓	✓	✓

*Dependent on manufacturer of device, length of catheter, and complimentary confirmation system.

It's acceptable to use a PICC line as soon as you place it when a p-wave is present, reducing the need for X-ray confirmation.[41]

PICCs can be used for short-term and long-term treatment

When a patient enters the ICU, consider the patient's condition, potential for long-term treatment, and overall health and comfort.

FICC

FICC use is limited to emergent placement by these authoritative organizations:

- Infusion Nursing Society[15]
- The Joint Commission[42]
- Asia Pacific Society of Infection Control[43]

If a FICC or other emergent line is placed under suboptimal aseptic technique, it should be replaced within 24 to 48 hours.[15,43]

CICC

Manufacturers may limit their CICCs to short-term use. CICCs may require insertion of multiple catheters throughout the patient's hospital stay resulting in more sticks, corresponding with high risk of central line associated bloodstream infection.[3]

PICCs are indicated for short and long-term dwell and can be used throughout the continuum of care.[19,26]

Putting patient assessment first

When a patient is admitted to the ICU, placing a PICC may **reduce insertion-related complications** (compared to other central vascular access devices), which may lead to mortality and morbidity.[20] PICC placement is **not dependent on supine or Trendelenburg positioning**.[9,36] PICCs offer an alternative vascular access solution for ICU patients to central lines inserted through the neck, chest, or groin and can **follow the patient throughout the continuum of care**.

For assistance on finding vascular access management solution for your patients and hospital, **speak to your BD representative**.

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