US-Guided Placement and Tip Position Confirmation for Lower-Extremity Central Venous Access in Neonates and Infants with Comparison versus Conventional Insertion

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ABSTRACT

Purpose: To describe experience with the use of ultrasound (US)–guided placement and tip position confirmation for direct saphenous and single-incision tunneled femoral noncuffed central venous catheters (CVCs) placed in neonates and infants at the bedside.

Materials and Methods: A retrospective review of the interventional radiology (IR) database and electronic medical records was performed for 68 neonates and infants who received a CVC at the bedside and for 70 age- and weight-matched patients with CVCs placed in the IR suite between 2007 and 2012. Technical success, complications, and outcomes of CVCs placed at the bedside were compared with those in an age- and weight-matched sample of children with CVCs placed in the IR suite.

Results: A total of 150 primary insertions were performed, with a technical success rate of 100%. Total catheter lives for CVCs placed at the bedside and in the IR suite were 2,030 catheter-days (mean, 27.1 d) and 2,043 catheter-days (mean, 27.2 d), respectively. No significant difference was appreciated between intraprocedural complications, mechanical complications (bedside, 1.53 per 100 catheter-days; IR, 1.76 per 100 catheter-days), or infectious complications (bedside, 0.39 per 100 catheter-days; IR, 0.34 per 100 catheter-days) between groups.

Conclusions: US-guided placement and tip position confirmation of lower-extremity CVCs at bedside for critically ill neonates and infants is a safe and feasible method for central venous access, with similar complications and catheter outcomes in comparison with CVCs placed by using fluoroscopic guidance in the IR suite.

ABBREVIATIONS

BSI = bloodstream infection, CI = confidence interval, CVC = central venous catheter, IVC = inferior vena cava, IR = interventional radiology, PICC = peripherally inserted central catheter, VT = venous thrombosis

Central venous access is indispensable in caring for patients with infections, malignancies, or chronic illnesses. It is traditionally believed that the femoral site should be reserved when no other access site is available, as stool contamination of the insertion site increases the risk of infection, although several studies have challenged this view (1–3). In addition, tunneling of the femoral central venous catheter (CVC) subcutaneously from the distal thigh increases the distance between the skin–catheter junction and venous insertion site, and has been shown prospectively to decrease the risk of catheter colonization (4).

In our institution, a lower-extremity single-incision tunneled CVC insertion is the procedure of choice in neonates who require vascular access at the bedside. For these procedures in which live fluoroscopy is not possible, the tip position can be reliably confirmed by using transabdominal ultrasonography (US), obviating fluoroscopic confirmation (5). Single-incision placement of tunneled femoral catheters in children has been described previously in a small series of children (6). However,

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confirmation of catheter tip position by using US alone has not been previously described in a larger series. The aim of the present study is to describe our experience with the use of US-guided placement and tip position confirmation for direct saphenous and single-incision tunneled femoral CVCs, which were placed in neonates and infants at the bedside. Technical success, complications, and outcomes of CVCs placed at the bedside are then compared versus an age- and weight-matched sample of children with CVCs placed in the IR suite.

MATERIALS AND METHODS

Following approval by the institutional review board, a retrospective review of the interventional radiology (IR) database was performed to identify all children who had received a saphenous or tunneled femoral CVC via single-incision technique between June 2007 and July 2012. Medical records were retrospectively reviewed for relevant clinical information. Data were then sorted based on location of CVC placement (ie, IR suite vs bedside). Data for all bedside catheter insertions were compared versus data for an age- and weight-matched group of patients selected from all catheters placed in the IR suite. From June 2007 until January 2011, procedure times were collected from physician procedure notes. From January 2011 until July 2012, procedure times were collected from technologist documentation in the newly instituted electronic record, with procedure time being defined as the time from procedure time-out to the physician leaving the IR suite or bedside.

Table 1. Patient Demographics at the Time of Catheter Insertions

	CVC Insertion		
Characteristic	**Bedside**	**IR Suite**	***P* Value**
Patient age			NS[†]
Mean (d)	48.8	48.1	
Median (d)	21	30	
Range	24.0 GW to 12 mo	26.3 GW to 9.4 mo	
Weight (kg)			NS[†]
Mean	3.7	3.5	
Median	3.6	3.3	
Range	0.6–9.2	1.1–8.5	
No. of insertions			NS[‡]
Preterm			
< 37 GW*	18	18	
> 37 GW*	18	20	
Term	39	37	

CVC = central venous catheter, GW = gestational week, NS = not significant.
*Age at the time of catheter insertion.
[†]Mann–Whitney *U* test.
[‡]χ^2 analysis.

A total of 75 CVCs were placed at bedside in 68 children (38 male and 30 female), and 75 catheters placed in the IR suite were identified in an age- and weight-matched group consisting of 70 children (37 male and 33 female).

Patients included preterm and term neonates and infants. Patient demographics are shown in Table 1, with ages adjusted for preterm neonates and infants. Primary admitting diagnoses and indications for primary insertions are presented in Tables 2 and 3. Bedside CVC insertions were performed in patients who would be at high risk with transport to the IR suite, including critical airway, extracorporeal membrane oxygenation, oscillator ventilation, gastroschisis or omphalocele surgery, preoperative congenital diaphragmatic hernia, severe cardiopulmonary reserve, or weight less than 1 kg (because of potential temperature instability).

Catheters chosen for primary insertions were noncuffed and included 1.9-F (7.3%) and 2.6-F (33.3%) peripherally inserted central catheters (PICCs; Medcomp,

Table 2. Primary Admitting Diagnoses

	CVC Insertion	
Diagnosis	**Bedside**	**IR Suite**
Congenital heart disease	19	26
Prematurity	15	17
Respiratory distress*	16	4
Congenital anomalies	3	4
Hyperinsulinism	1	7
GI disease/feeding intolerance	6	4
Infection	3	6
Congenital diaphragmatic hernia	4	2
Metabolic abnormality	–	2
Malignancy	–	1
Cardiopulmonary distress after sedation	1	–
Total admissions	68	73

CVC = central venous catheter, GI = gastrointestinal.
*Secondary to pulmonary disease, respiratory infection, or lymphatic malformation.

Table 3. Indications for Primary Catheter Insertions

	CVC Insertion	
Diagnosis	**Bedside**	**IR Suite**
Cardiovascular/respiratory support*	45	30
Total parenteral nutrition	13	20
Access[†]	12	14
Long-term antibiotic therapy	5	11
Total catheter insertions	75	75

CVC = central venous catheter.
*Congenital heart disease and respiratory failure.
[†]Antibiotics, total parenteral nutrition, medication, transfusions.