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Femorally inserted central catheters with exit site at mid-thigh: A low risk alternative for central venous catheterization

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Abstract

Background: Femorally inserted central catheters are increasingly used, especially after the COVID-19 pandemic, also thanks to widespread of tunneling techniques that allow the exit site to be moved away from the groin.

Methods: In this retrospective observational study, femorally inserted catheters, with exit site at mid-thigh and the tip in Inferior vena cava or in Inferior vena cava at the junction with right atrium, have been observed and complications have been analyzed. All catheters were inserted by trained Nurses of a tertiary hospital Vascular Access Team.

Results: In 142 catheters (126 inserted via common femoral vein and 16 inserted via superficial femoral vein) and 3060 catheter days, we observed an infection rate of 1.3 events/1000 catheter days (all of them in oncologic patients and up to 30 days of catheterization), 2 cases of thrombotic events (1.41%) and 17 cases of accidental removal (11.97%). Other rare complications, as primary malposition, tip migration, arterial pseudoaneurysm, have been recorded. The average length of catheters inserted, from the exit site to the tip, was 47.6 ± 2.4 cm.

Conclusion: The attention to the correct position of the tip, the exit site at mid-thigh and the new techniques during insertion make these femoral catheters as safe as other central vascular access devices. For this kind of central access device, a catheter at least 50 cm long is needed.

Keywords

Nursing, femoral catheter, ultrasound, subcutaneous tunnel, FICC, central access

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Introduction

The availability of a central vascular access device (CVAD) is often needed for a correct intravenous drug administration. Infusion Therapies Standards of Practice Guidelines recommended a Peripherally Inserted Central Catheter (PICC) as first choice for a CVAD. If the veins of the arm are not available, the second choice is a Centrally Inserted Central Catheter (CICC). Femorally Inserted Central Catheter (FICC) is recommended in only few cases, for example: Superior Vena Cava Obstruction (SVCO), emergency catheterization, short term dialysis catheterization.[1]

FICCs with exit site at the groin are historically associated to a high risk of catheter related complications. (A) Catheter related blood stream infection (CRBSI) due to the exit site at the inguinal crease,[2] in a highly contaminated area. (B) Catheter related Deep Venous thrombosis (CRDTV) with secondary pulmonary embolism.

In recent decades, US-guided venipuncture has become the standard in CVAD placement. At the same time tunneling techniques have spread considerably. This evolution improved the approach through the common femoral vein (CFV) and offered the possibility of moving the exit

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site away from the inguinal crease by tunneling the catheter at the mid-thigh.[3] At the same time, US guided venipuncture allowed to approach the superficial femoral vein (SFV) at mid-thigh, as recently reported by Annetta et al.[4] and Gidaro et al.[5]

During COVID 19 pandemic, the femoral approach was recommended and widely used due to the distance from the patient's airways, the lower risk of dislocation than CICCs during pronation manoeuvres and the absence of interaction with the CPAP helmet, often used in the treatment of COVID 19 pneumonia.[5–8]

Since 2020, Nurses of an Italian tertiary hospital Vascular Access Team (VAT), started using femoral approach in CVAD positioning as alternative to PICCs, when the veins of the arm were unavailable and a CICC was not indicated or the intraprocedural risks of CICC positioning were too high.

Aim of this study is a retrospective analysis of outcomes related to FICCs with exit site at mid-thigh as alternative to PICCs, in particular regarding catheter related major complications.

Methods

In this observational retrospective study, FICCs inserted from November 2020 to May 2022 have been analyzed. All catheters have been inserted bedside by trained Nurses of the local VAT.

Indications to FICC positioning

The criteria for FICC positioning were the need of a central line for therapy administration and veins of the arm not available and (A) too high risks for CICC insertion as alternative to a PICC or (B) presence of SVCO.

FICC insertion technique

Catheters inserted were PICC Power Injectable made by Teleflex® Medical Europe—Dublin—Ireland, 1 lumen (4fr) and 2 lumens (5fr), with procedural kit for maximum sterile barrier precautions.

ALL FICCs observed were inserted, after obtaining an informed consent, in adherence with current best practices, including the use of a micro-introducer kit consisting of a 21-gauge echogenic needle, a 0.018″ nitinol guidewire with straight soft tip, and a micro-introducer/dilator.[9] After Ultrasound (US) scan of the anatomic area before catheter insertion, according with RaFeVA protocol,[10] the operator chose between common femoral vein (CFV) or superficial femoral vein (SFV) according to his preference/skill, the anatomical characteristics of the patient, and the need to maintain an ideal catheter-vein ratio (1:3 or less). The insertion of the FICC was performed after skin antisepsis with 2% chlorhexidine in 70% alcohol, hand hygiene obtained with hydroalcoholic gel and adoption of maximal sterile barrier precautions.[11]

US-guided venipuncture was performed by visualizing the vein/needle both in oblique axis/in plane (for SFV) and in short axis/out of plane (for CFV),[4,9] the guide wire was subsequently observed in both long and short axis to ensure correct positioning in the target vein.

Catheters inserted via CFV were tunneled at mid-thigh using an introducer kit (Radiofocus® Introducer II, Terumo Medical, Elkton, MD, USA). Catheters via SFV were inserted by the "Extended Subcutaneous Route" technique or "pseudotunnel"[3,12,13] and possibly a further tunnel.

Tip location

All FICCs were placed with their tips located at the junction between the Inferior Vena Cava (IVC) and the Right Atrium (RA) or, as second choice, in the upper portion of the IVC.[14–16] Catheters available were 50 cm long so the choice of tip location in IVC or IVC/RA depended mainly on the size of the patient and the required tunnel length. Whenever possible intraprocedural tip location was performed with echocardioscopy, a 2–6 MHz sectorial probe by a subcostal bicaval view was used,[17] either with direct visualization of the catheter or with a bubble test (considering no more than 1 s as indicator of correct positioning). In one case intracavitary ECG was performed.[17,18] In the absence of ultrasound windows, a post-procedural abdomen X-ray was asked. In these cases, the position of the tip no more than 10 cm below the projection of T10 was considered acceptable.

Catheter securement

FICCs were secured with an adhesive-based securement device (Grip Lok® Vygon, Ecouen, France) or a subcutaneous anchorage securement (SAS) (SecurAcath®; Interrad Medical, Minneapolis MN, USA). All catheters were protected with cyanoacrylate glue (Exofin 0.5 ml, Chemence Medical, Alpharetta, GA, USA) and semipermeable transparent membrane (Touchmed Film IV, Dealfa s.r.l., Monza, Italy). The choice between adhesive-based securement device and SAS was based on the estimated duration of infusion therapy. The SAS was placed if the expected time was more than 15 days, according to VAT internal protocol.

Data collect and statistical analysis

The study was approved on November 04, 2021 by the local Ethics Committee (Comitato Etico Brianza – ref. 561). We analyzed data about age, sex, catheter length, number of lumens, catheter measure, vein measure, tip location technique, catheter securement, catheter days, removal reason, CRBSI, CRDTV, accidental removal, and

Table 1. Main characteristics of the sample.

Catheters (*n*)	142	
Age (mean ± SD)	66 ± 16	
Male (*n*)	73	$p = 0.784$
Female (*n*)	69	
Medical disease (*n*)	111	$p < 0.001$
Surgical disease (*n*)	31	
CFV approach + tunnel (*n*)	126	
SFV approach + pseudotunnel (*n*)	14	
SFV approach + tunnel (*n*)	2	

any other adverse event potentially related to the catheter. Infections confirmed by positivity to blood cultures, in peripheral vein and FICC, for the same pathogen with delayed time to positivity greater than 2 h were considered as CRBSI. Thrombotic symptomatic events or asymptomatic events with incidental findings in femoral vein, iliac vein, or IVC, requiring anticoagulation treatment, were considered as CRDTV. There is no data available about fibroblastic sleeve.

All the data were analyzed using Microsoft Excel 2021. Values for continuous variables are expressed as mean ± SD, Median, and quartile 1–3. Values for categorical variables are expressed as frequencies or percentage. CRBSI and CRDTV rate are even expressed in events/1000 catheters days.

Results

Around 3060 catheter days were analyzed. We observed 142 consecutive FICCs, (23 one lumen 4 Fr and 119 bilumen 5 Fr) inserted from November 2020 to June 2022 by trained Nurses of the local VAT. Mean ± SD of the catheter's length, from the exit site to the tip, was 47.6 ± 2.4 cm. None of the catheters were previously trimmed. The catheters available were all 50 cm long so the anthropometric characteristics of the patients were the main discriminating factors for the position of the tip in IVC or IVC/RA. The characteristics of the sample are summarized in Table 1.

Tip location technique was abdomen X-ray in 48 (33.8%) patients and echocardioscopy in 94 (66.2%) patients. Abdomen X-rays identified four primary malpositions requiring immediate catheter replacement. Echocardioscopy, performed when an ultrasound window was available, allowed correct tip location in all procedures involved.

Catheter securement was SAS in 94 (66.2%) and adhesive-based in 48 (33.8%) patients. FICCs accidentally removed were 17, secured by SAS in 5 patients and adhesive-based in 12 patients ($p < 0.001$).

In 12 cases a second attempt was needed for vein cannulation. In one case an unlikely accidental unrecognized puncture of the femoral artery caused the formation of a pseudoaneurysm. Frequent and occasional complications occurred are summarized in Table 2. Catheters outcomes are summarized in Table 3.

Table 2. Frequent and occasional catheter related complications observed.

Complication	*n*	%	Events/1000 cat. days
Accidental removal	17	11.97	
CRBSI	4	2.82	1.33
CRDTV (symptomatic + asymptomatic)	2	1.41	0.66
Primary Malposition (replacement needed)	4	2.82	
Pseudoaneurysm (femoral artery)	1	0.70	
Tip migration during CT scan	1	0.70	

Discussion

Our results show a complication rate similar to other CVADs, historically considered as lower risk affected than femorally inserted catheters with exit site at the groin.[19–22] FICC is not recognized as first choice for central vein catheterization and strong indications for femoral approach are very few. The reluctance in non-dialysis FICC use is explained by a high rate of complications.[2,23,24] The new possibilities of deciding the location of the exit site have considerably modified this situation.[6,14,16] Regarding the CRBSI rate (1.32 events/1000 catheter days), all four cases occurred after a 30 days of catheter stay (range 31/97 days) undergoing outpatient chemotherapy. No events were registered during hospital stay. The favourable position of the exit site at mid-thigh may have contributed to significantly reduce the infectious risk. Koo et al.[25] recently showed a correlation between tunneled FICC increased infectious risk and indwelling time up to 1 month in a pediatric population, our results seem to confirm this trend.

CRDTV were identified in two patients (1.41%). Both were hospitalized for oncohematological disease. In the first one it was a thrombosis of the CFV with consequent pulmonary embolism. After the start of the anticoagulant treatment, the patient kept the catheter in place and continued the ongoing therapy until the scheduled end. In the second patient, asymptomatic partial thrombosis of the IVC was identified as an occasional finding during CT scan.

CRDTV rate observed is not higher than other catheter types.[23] The higher risk recognized in current literature[1] depends on various factors. The new materials, insertion techniques, and the attention to the position of the tip may have contributed to the observed risk reduction.

Non dialysis femoral catheters inserted in the last years were usually the same used for jugular or subclavian vein approach (20 cm long, up to 7 French). The catheters used

Table 3. Catheter outcomes and length of stay.

Outcomes	*n*	Length of stay (days)
		Median (q1–q3)
Discharged (catheter in place)	31	9 (4–23)
Discharged (catheter removed)	42	16 (11–22)
Death	27	8 (3–14)
Accidental removed	17	4 (1–8)
Complication	11	46 (20–91)
No more necessary	10	33 (23–44)
End of study observation (still in place)	4	21 (19–27)

Figure 1. 20 cm catheter length at inguinal fold (iliac vein) versus 50 cm catheter length at mid-thigh (IVC).

in this study were long enough to reach the IVC/RA or, at least, the upper portion of IVC.[9] The risk of using normal 20 cm catheters during femoral access may be that they are not long enough to reach the IVC, remaining in the iliac veins and therefore in a more peripheral position (Figure 1). In this case, the infusion of solutions not compatible with the peripheral vein could increase the risk of endothelial damage and the possibility of thrombotic events. To have the characteristics of CVAD, the catheter must be much longer than 20 cm.

Other favorable factors such as smaller catheters and catheter/vein ratio, greater softness and biocompatibility, less traumatic introducer set, US guided venipuncture with fewer attempts must also be considered to explain the risk reduction.

Accidental removal is the most frequent adverse event occurred. It is interesting the difference between FICCs secured by adhesive-based securement and by SAS. The very lower risk of removal using a SAS ($p < 0.001$) confirms the previous literature[26,27] and makes this device advisable.

Femoral approach is not, obviously, the first choice for a CVAD but if the veins of the arm are not compatible with the placement of a PICC, this femoral approach may represent a valid alternative even for medium or long term and in patients with normal mobility. This study has many limits. First is a monocentric experience and may be not representative of the global reality of vascular accesses. As observational retrospective study, the sample choice is very heterogeneous and, in a next analysis, it would be desirable to better stratify the patients and better identify complications risk factors, so further studies are required to clarify this topic. The nurses involved were very well skilled in FICC placement but not well skilled in echocardioscopy, this may be a reason of the numerous abdomen X-rays observed. It would be interesting to identify a skill level required for these procedures, at this time not yet clear.[17]

Conclusion

FICC, with exit site at mid-thigh and tip in IVC or IVC/RA, is a possible alternative to PICC or CICC in some patients for short, medium, or long term central catheterization need. For this kind of femorally inserted central access devices, a catheter at least 50 cm. long is advisable and it would be desirable to use the term FICC, in adult patients, only for catheters much longer than 20 cm. The new generation catheters and the adoption of precautions recommended in the literature make the use of FICCs as safe as other CVADs.

Author contributions

All authors equally contributed to the data collection and writing of the manuscript.

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