

# Safety and Efficacy of Mobility Interventions in Patients with Femoral Catheters in the ICU: A Prospective Observational Study

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## ABSTRACT

**Introduction:** There are limited data describing mobility interventions provided to patients with femoral catheters. The purpose of this study was to examine the incidence of femoral catheter related adverse effects during physical therapy (PT) sessions in a cardiovascular intensive care unit (ICU). **Methods:** This was a prospective, observational study and included patients with at least one femoral catheter. Data were collected after each PT session. **Results:** There were 77 subjects with a total of 92 femoral catheters (50 arterial, 15 central venous, and 27 dialysis) treated. A total of 210 separate PT sessions occurred with 630 mobility activities including sitting on side of bed, standing at the bedside, transfers to stretcher chair or regular chair, and walking. There were no catheter related mechanical or thrombotic complications during any of the PT sessions. **Conclusions:** Physical therapy sessions, including standing and walking were feasible and safe in cardiovascular ICU patients with femoral catheters who met the criteria for mobility interventions. The results from this study support the hypothesis that early mobilization in patients with femoral catheters is important to minimize functional decline and provide evidence that the presence of femoral catheters alone should not be a reason to limit progressive mobility interventions.

**Key Words:** physical therapy, ICU, early mobilization, femoral catheter

## INTRODUCTION

Central arterial and venous catheters are used in the treatment of critically ill patients. These catheters are required in the management of life saving treatments but

can also be associated with infections, thromboses, and mechanical complications. The decision about location of cannulation site is made by a physician and is usually related to individual patient considerations. Cannulation of arterial and venous femoral vessels has been identified as a potential and actual barrier to hip flexion, sitting, standing and walking for patients in the intensive care unit (ICU).<sup>1-5</sup> Femoral arterial catheterization for hemodynamic monitoring is the most commonly used location after the radial artery, particularly in medical ICU settings.<sup>6</sup> Venous access is used to administer medications or fluid, allow blood sampling, monitor pressure, and provide access for dialysis.<sup>7-9</sup> There are limited data describing the safety or tolerance to mobility interventions provided to critically ill adults with femoral catheters. The purpose of this study was to examine the incidence of femoral catheter related adverse effects during physical therapy interventions for adult patients in a cardiovascular ICU.

## BACKGROUND

Restriction of either limb or whole body mobility in patients with femoral cannulation is often due to unsubstantiated concerns about kinking or breaking the catheter, accidental loss of access, line disconnection with subsequent bleeding, occlusion or thrombosis formation, vessel injury (eg, pseudoaneurysm, especially from rigid catheters), and increased potential for site contamination related to dressing dislodgement. Our review of the literature within the fields of critical care medicine, nursing, and physical therapy has yet to find published reports of adverse outcomes related to mobility of patients with femoral arterial catheters in the ICU. Studies in healthy human subjects with a cannulated femoral artery or vein were performed to evaluate physiologic effects using leg resistance exercises in a sitting position or during upright positioning on a treadmill.<sup>10-12</sup> The authors reported no femoral catheter related complications despite repetitive and acute hip flexion in these protocols. Different authors with healthy adults specifically reported no complications such as premature removal of catheters, ecchymosis

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or hematoma, or the persistence of pain after catheter removal.<sup>13</sup> A recent study indicated that a common reason for inability to mobilize patients during a physical therapy (PT) session was the presence of a femoral catheter.<sup>2</sup> However, a retrospective case series examining the use of a progressive mobility protocol for ICU patients with femoral arterial catheters reported no catheter related complications.<sup>14</sup> Anecdotally, for as long as two decades, the authors have assisted patients with femoral catheters with mobility activities in the ICU without adverse outcomes. Conflicting opinions and study results suggest there is a clinical need for investigating the feasibility and safety of mobilizing patients in ICU with one or more femoral catheters.

## METHODS

This was a prospective, observational study. The study was approved by The Methodist Hospital Institutional Review Board and all enrollees or their surrogates provided informed consent. All patients or surrogates approached for consent agreed to participate in the study.

### Setting

The study was conducted in a 40-bed cardiovascular surgical intensive care unit (CVICU) at a large metropolitan 900-bed teaching hospital from 2009 to 2010. The CVICU has a mixed population of adult cardiovascular and thoracic surgical patients.

### Sample

Inclusion criteria were consecutive patients 18 years of age or older who had at least one femoral catheter and met criteria for a PT intervention. Patients referred for PT were required to be awake, able to follow most directions (ie, 2 out of 3 commands), and hemodynamically stable as per following criteria: heart rate < 110/min at rest, mean arterial blood pressure 60 to 110 mmHg, and fraction of inspired oxygen < 0.6.<sup>15</sup>

The catheters included in this study were femoral central venous catheters, dialysis catheters, and arterial catheters for hemodynamic monitoring. Table 1 details the specific catheters used during the study. Patients with a femoral sheath catheter in place were excluded because, according to the nursing policy in this facility, patients with sheaths have their activity restricted to bed rest. The femoral catheter insertion methodology was consistent and standardized among physicians via the Modified Seldinger approach.<sup>5</sup> The catheters were sutured at the insertion site and dressed with a sterile transparent occlusive dressing.

## Procedure

The PT inspected the catheter sites before and after each PT session. The site was checked for proper catheter securement and any signs of bleeding. Information about appropriate function of different kinds of catheters was provided by the nurse. The nurse also provided all interventions related to the management of the femoral lines including dressing changes, flushing, monitoring of waveforms, and occasionally disconnecting the catheters if appropriate. In the event that the PT identified an area of concern related to the catheters, the concern was addressed by the nurse prior to any mobility activity. There were no restrictions on the degree of hip flexion or the duration of mobility activities, however repetitive hip flexion through the full range of motion such as cycling exercise was not performed in these patients.

All patients in the study were managed with CVICU standard protocols and procedures including a program for mobilization.<sup>15</sup> The progressive mobility activities included sitting on the side of bed, standing at the bedside, transfer to a stretcher chair, transfer to a regular chair, and walking. Sitting on the side of the bed was defined as the patient sitting with both legs dangling with or without assistance to attain or maintain trunk stability/posture/upright positioning. Standing at the bedside was defined as having the patient stand and bear weight on the legs using a walker and/or assistance. Transfer to stretcher chair was defined as a dependent lateral supine transfer from bed to the stretcher chair with staff assistance in patients unable to bear weight. Transfer to a regular chair was defined as having the patient actively participate by standing and taking steps with assistance while moving from bed to the chair. Walking was defined as the patient actively taking steps away from the bedside using a rolling walker and assistance.<sup>15</sup> Physical therapy sessions typically lasted 30 to 60 minutes. There were no restrictions on the length of time for sitting on the side of bed, sitting in the stretcher chair or regular chair. All patients returned to bed from the chair position assisted by the nursing staff. When a patient participated in more than one mobility activity during a PT session, such as sitting at the side of bed and standing, both activities were recorded.

## Data Collection

All data were collected by PTs who also screened patients for study eligibility and obtained consent. The demographic data collected were age, gender, height/weight/body mass index, admitting diagnosis, comorbidities, and ability to participate in activity. Next, information about the type(s) of catheters was recorded. Prior to the mobility session the catheter site was inspected for bleeding, proper catheter securement, and dressing appropriately held in place. The

**Table 1. Types of Catheters**

Brand	Type	Length	Diameter	
Arrow™	Arterial (single lumen)	12 centimeters (cm)	1.1 millimeters (mm)	20 gauge
Arrow™	Venous (3 lumen)	16 or 20 cm	2.4 mm	7 French
Quinton™ Permacath™	Venous dialysis catheter	23 cm	2.5 mm	15 French

affected lower extremity was also inspected for its color, presence of numbness or tingling, and strength of pedal pulses, and all data were recorded. At the end of each PT session the catheter site and lower extremity were again inspected, the mobility activities documented, and all data post-mobility recorded.

Directly observed data collection ended when either the femoral catheter was removed or the subject was discharged from the CVICU.

## RESULTS

### Demographic Data

We prospectively enrolled 77 patients with femoral catheters. The range in age was 18-85 years and there were nearly equal numbers of men and women. Table 2 summarizes demographic data. Fifty patients (65%) were either overweight or obese with a BMI > 25. Thirty-four (44%) of the patients received mechanical ventilation during the first PT session. Of these 34 ventilated patients, 24 were awake and alert on the initial visit. While the remaining 10 ventilated participants were lethargic during the initial visit, only two (3%) were unable to follow two out of 3 commands; they became much more alert with mobility activities and tolerated planned interventions well.

### Femoral Catheters

A total of 92 femoral catheters were present in the 77 subjects in this study. This included 50 arterial, 15 central venous, and 27 dialysis catheter. Table 3 details the number of each type of femoral catheters and various combinations of the 3 types when more than one catheter was present. Sixty four patients (83.12%) had a single femoral catheter, 11 patients (14.28%) had two femoral catheters, and two patients (2.6%) had 3 femoral catheters. In this sample, central venous femoral lines were in place a mean of 7 days (range 1-25 days with SD 6.4) before the first PT session. Arterial and dialysis catheters were in place for a mean of 6 days before the first PT session (range 0-19 days with SD 4.8 and 1-25 days with SD 6.4, respectively). The baseline assessment of femoral catheters revealed only one instance in which there was an area of concern prior to starting a PT session. In this case there was evidence of minimal bleeding at the insertion site of an arterial catheter, which was unchanged after mobility activities were performed.

### Physical Therapy Sessions

All 77 patients received at least one PT session and the first session typically began 5 to 7 days after ICU admission for the majority of participants. A total of 210 separate

**Table 2. Patient Demographic Information**

Variables	% (n) unless indicated	
Age (years)	Mean 59 (SD = 17)	
Gender (number of males)	53% (41) males	
Body Mass Index – BMI (kg/m <sup>2</sup> )	Underweight (< 18.5)	7.8% (6)
	Normal (18.5-24.9)	27.3% (21)
	Overweight (25-29.9)	27.3% (21)
	Obese (> 30)	37.7% (29)
Admitting Diagnoses	Single or double lung transplant	31.1% (24)
	Aortic and/or mitral valve replacement or repair with or without coronary revascularization	20.8% (16)
	Heart or heart/lung mechanical support (ECMO, LVAD – HeartMate™)	11.7% (9)
	Coronary Artery Bypass Graft surgery	11.7% (9)
	Aortic aneurysm repair	6.5% (5)
	Atrial tumor resection	3.8% (3)
	Heart transplant	3.9% (3)
	Heart and lung transplant	2.6% (2)
	Other: pneumonia, ARDS, endocarditis, femoral bypass, pulmonary emboli, GI bleed, bowel perforation, MI with infected catheter, lobectomy for lung cancer, pancreatitis, and lysis of abdominal adhesion	14.3% (11)
Number of comorbidities, mean	Mean 2	
Most common: HTN (57%), DM (29%)		
Length of Stay – LOS (days)	Intensive Care Unit (ICU)	Mean 20.9 (SD = 19.7)
	Hospital	Mean 33.1 (SD = 21.9)
Level of Consciousness during first Mobility Session	Awake and followed 2 out of 3 directions	79% (61)
	Lethargic and followed 2 out of 3 directions	18% (14)
	Lethargic and unable to follow 2 out of 3 directions	2.6% (2)

Abbreviations: SD, standard deviation; ECMO, extracorporeal membrane oxygenation; LVAD, left ventricular assist device; ARDS, acute respiratory distress syndrome; GI, gastrointestinal; MI, myocardial infarction; HTN, hypertension; DM, diabetes mellitus

**Table 3. Number of Patients and Types of Femoral Catheters in Place during First Physical Therapy Session**

	Arterial	Central Venous	Dialysis	Arterial and Dialysis	Arterial and Central Venous	Central Venous and Dialysis	Arterial, Dialysis, and Central Venous
<b>Number of Patients</b>	39	7	18	5	4	2	2

PT sessions occurred as detailed in Table 4. There were a total of 630 mobility activities during all PT sessions. The mobility activities included the following occurrences: 210 sitting on the side of bed (33.34%), 138 sitting in the stretcher chair (21.9%), 69 sitting in a regular chair (10.95%), 154 standing at the bedside (24.45%), and 59 walking activities (9.36%). The number of PT sessions per subject is also detailed in Table 4 with 21 subjects engaged in one session, 23 subjects receiving two sessions, and 33 subjects receiving 3 or more PT sessions. Nineteen patients (25%) with femoral catheters were able to walk on the initial PT session. There were a total of 57 walking activities in this sample. Patients were able to ambulate with a rolling walker and assistance for at least two minutes with variable distances according to individual capabilities.

#### Incidence of Catheter-Related Adverse Effects

There were no catheter related mechanical or thrombotic complications either during or immediately following a mobility session, which was usually 15 to 20 minutes after the activities were completed. There were no observations of bleeding, hematoma at catheter insertion site, line dislodgement/accidental catheter removal, nonfunctioning catheter, or change in vascular status such as pain, loss of pulse, or evidence of reduced perfusion distal to the insertion site on the leg with the catheter.

#### DISCUSSION

This study examined adult CVICU patients with at least one femoral catheter during early progressive mobility provided by PT and there were no adverse catheter related events. The data from this prospective study indicate that

early mobility and walking in the CVICU for selected patients with femoral arterial and venous catheters is feasible. Evidence for safety is supported by the large number of sessions (ie, 210 PT sessions) and activities (ie, 630 separate activities) including sitting, standing, and walking while femoral arterial and venous catheters were in place and without any areas of concern prior to starting mobility activities. Even when patients had more than one femoral catheter, no adverse events occurred during a PT session. These data are congruent with reports in the literature about healthy adults who perform activity with femoral catheters.<sup>10-13</sup> The findings from the current prospective study are also congruent with a retrospective analysis of patients with femoral catheters.<sup>14</sup> The prospective data from this study, in a sample of complex and critically ill adults provides new information to clinicians and researchers about feasibility and safety regarding sitting, standing, and walking activities in critically ill adults.

There were several limitations in this study. This was a single site study enrolling only postoperative patients in CVICU. A control group was not possible since routine care in this ICU includes an early mobilization program for all patients who meet criteria. The majority of patients in this study underwent lung transplantation, which is an uncommon diagnosis across all ICUs in the United States or abroad. While recipients of lung transplants are unique, they do provide a model of high acuity care, suggesting that femoral catheters should not be considered a barrier to early progressive mobilization even for high acuity patients in ICU settings.

The study did not follow patients long enough to determine if PT sessions contributed to a catheter related

**Table 4. Number of Physical Therapy Sessions by Type of Femoral Catheter**

Type of Femoral Catheter	Number of Physical Therapy Sessions									Number of catheters (n)
	1	2	3	4	5	6	7	8	11	
Arterial	14	9	6	5	2	1	1	1	0	39
Central	2	3	1	0	1	0	0	0	0	7
Dialysis	3	5	4	4	0	1	1	0	0	18
Arterial & Dialysis	2	2	0	0	0	0	0	0	1	5
Arterial & Central	0	3	1	0	0	0	0	0	0	4
Arterial, Central, & Dialysis	0	1	0	1	0	0	0	0	0	2
Central & Dialysis	0	0	1	1	0	0	0	0	0	2
<b>Total Number of Catheters (n)</b>	<b>21</b>	<b>23</b>	<b>13</b>	<b>11</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>11</b>	
<b>Total Number of Sessions = 210</b>	<b>21</b>	<b>46</b>	<b>39</b>	<b>44</b>	<b>15</b>	<b>12</b>	<b>14</b>	<b>8</b>	<b>11</b>	

infection or thrombosis long after the mobility activity. However, in the patients with 3 or more PT sessions, neither thrombosis nor infection was observed between sessions. It is possible that patients with a longer or shorter duration of catheter placement than those in this sample may have a different vessel profile that alters risk for vessel damage or dislodgment further limiting generalizability.

Due to limited publications on the safety of mobility activities for patients with femoral catheters, most ICUs consider their presence as a reason to keep patients immobilized in bed, which could expose these patients to the unnecessary adverse effects of bedrest. The results of this study suggest that the presence of femoral catheters should not be considered a barrier to mobility.

Resources in the ICU setting, such as the unit-based PT or a progressive mobilization program, may not be common in other ICUs. All PT sessions were provided by experienced PTs with extensive clinical expertise in the care of critically ill patients. It is not possible to determine if the same results would occur with either non-PT providers or when the PT is not experienced in care of critically ill adults. However, with the growing body of evidence about the safety and benefits of early, progressive mobility in ICU and among mechanically ventilated patients, findings from this study may lend support to the addition of resources, such as a unit-based PT, to promote mobility activities.

The strength of this study is that we report observations from a large number of mobility activities, including walking, for patients who might be restricted to bedrest in some ICU settings.<sup>16</sup> Common mobility activities in an ICU setting occurred with both single and multiple femoral catheters in this study. Mobility activities did not result in any immediate catheter related complications, similar to a report in healthy adults and in a retrospective chart review study of patients in ICU.<sup>13,14</sup>

Future studies should include a longer period of observation following mobility activities. It may be that complications such as pseudoaneurysm do not appear until long after the femoral line has been removed. A larger cohort may also capture infrequent but important complications. Studying different ICU populations will provide additional information for safe, effective clinical practice. This study, along with replication studies, may promote unit-based guidelines for initiation and progression of mobility activities for adult patients in ICU that can improve their recovery after an episode of critical illness.

## CONCLUSIONS

It is feasible and safe to provide progressive mobility activities in cardiovascular ICU patients with femoral catheters who meet the criteria for mobility interventions. Subjects with a variety of femoral catheters did not experience catheter related complications during PT sessions with multiple mobility activities that included hip flexion. The results from this study provide evidence that the presence of femoral catheters alone should not be a reason to limit progressive mobility interventions.

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