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Management and vessel health in intensive care units and oncology settings led by vascular access team nurse specialists: a brief report

Gestione e benessere dei pazienti nelle unità di terapia intensiva e nei reparti di oncologia sotto la guida di infermieri specializzati in accesso vascolare: una breve relazione

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ABSTRACT

Introduction: the assessment of vessel health plays a central role in improving the general care pathways. To ensure an effective assessment and appropriate management, the presence of a dedicated Vascular Access Team (VAT) is paramount, especially in intensive care units and oncology settings. The objective of this longitudinal study was to investigate the incidence of complications associated with PICC management by the VAT in two healthcare settings in central Italy. A total of 78 patients were observed across three months.
Results: the sample was predominantly male (55.1%), had a mean age of 79 years (SD=16.43) and underwent implantation of PICCs. Chemotherapy (38.5%) and antibiotics (28.2%) were the most prevalent types of drugs administered through this device.
Discussion: at three months' follow-up, complications recorded included catheter-related bloodstream infections (0.71 per 1,000 catheter-days) and venous thrombosis (0.28 per 1,000 catheter-days).
Conclusions: nurse-led VAT management was associated with low PICC-related compli-cation rates at three months. Structured protocols, staff training and outcome monitoring may improve patient safety in ICUs and oncology settings.

Key words: nurse specialists; catheterization, peripheral; complications; treatment outcome.

RIASSUNTO

Introduzione: la valutazione dello stato di salute dei vasi sanguigni riveste un ruolo centrale nel miglioramento dei percorsi di cura generali. Per garantire una valutazione efficace e una gestione adeguata, la presenza di un team dedicato agli accessi vascolari (VAT) è fondamentale, specialmente nelle unità di terapia intensiva e nei reparti di oncologia. L'obiettivo di questo studio longitudinale era quello di indagare l'incidenza delle complicanze associate alla gestione dei PICC da parte del VAT in due contesti sanitari dell'Italia centrale. Sono stati osservati in totale 78 pazienti nell'arco di tre mesi.
Risultati: il campione era prevalentemente di sesso maschile (55,1%), aveva un'età media di 79 anni (SD=16,43) ed era stato sottoposto all'impianto di PICC. La chemioterapia (38,5%) e gli antibiotici (28,2%) sono stati i tipi di farmaci più prevalenti somministrati attraverso questo dispositivo.
Discussione: al follow-up di tre mesi, le complicanze registrate includevano infezioni del sangue correlate al catetere (0,71 per 1.000 giorni-catetere) e trombosi venosa (0,28 per 1.000 giorni-catetere).
Conclusioni: la gestione dei PICC da parte di un VAT infermieristico è risultata associata a bassi tassi di complicanze a tre mesi. Protocolli strutturati, formazione del personale e monitoraggio degli esiti possono migliorare la sicurezza del paziente in terapia intensiva e oncologia.

Parole chiave: infermieri specializzati; cateterizzazione periferica; complicanze; esito del trattamento.

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Introduction

Management of vessel health by specialist nurses is widely recognized as in the care pathways for both hospital and community settings.[1] Specialist nurses in vascular access management have significant academic and experiential training to proactively manage patients requiring placement of vascular access.

A Peripherally Inserted Central Catheter (PICC) is a central venous cannula inserted through the peripheral veins of the extremities, generally the basilic, brachial, cephalic and axillary veins. PICCs are indicated for patients receiving therapies for periods longer than 5 days or when irritating medications or solutions are required.[2] Most common complications associated with PICCs include Catheter-Related Bloodstream Infections (CRBSI), venous thrombosis, and mechanical failure (PICC migration and obstruction).[3-5]

In healthcare settings, identification of a Vascular Access Team (VAT) for proactive vascular access management has become common practice; VAT comprises healthcare professionals who have advanced knowledge and skills in assessment, insertion, clinical care, and management of vascular access devices.[6-8] These professionals include nurses, clinicians, therapists, and technicians.

A team-based vascular access approach improves dialysis outcomes, reduces catheter-related complications,[6] enhances efficiency, staff satisfaction, and resource use;[7] even intern-led models show educational and clinical benefits, while advanced VAT practice supports vessel health and positive patient and organizational results.[8]

Advanced practice led by VAT can improve vessel health with positive impacts on patient and organizational outcomes.[9,10]

Healthcare settings, such as Intensive Care Units (ICU) and oncology settings require the provision of peripherally inserted central venous devices to ensure life resuscitation procedures or administration of fluids, chemotherapy, sedatives, Total Parenteral Nutrition (TPN) and antibiotics.[11] Although complications associated with the management of PICCs are frequently reported in the literature, many studies fail to specify whether vascular access was managed by specialized teams. However, a systematic review has investigated the effectiveness of Vascular Access Specialist Teams (VASTs) in the insertion and maintenance of vascular devices, highlighting their potential role in reducing device failure and complications.[12]

Therefore, the aim of this study was to observe the incidence of complications associated with PICCs management by the VAT in 2 ICUs and oncology settings in central Italy.

Materials and Methods

A prospective observational study was conducted on 78 consecutive patients who underwent PICC placement performed and managed by the VAT in two clinical settings, ICU and Oncology Department, within two public hospitals in central Italy.

Adults (≥18 years) with a clinical indication for PICC were consecutively enrolled from September 2023 to January 2024 without exclusions or stratification; the study is a descriptive analysis based on VAT availability.

Complications were monitored prospectively for three months following catheter insertion.

VAT comprised specialist nurses with advanced training in vascular access management. Nurses held advanced academic certification or documented formal training in vascular access insertion and ongoing care. Anesthesiologists were involved solely in a supportive role and did not participate in daily vascular access management or vessel health–related decision-making.

Management of vessel health was followed by a clinical protocol according to standard practices (Table 1).[13,14]

Table 1. Strategies recommended to prevent complications associated with PICC management.[13,14]

Management
Aseptic technique
Hand washing before insertion and manipulation of a catheter
Maximal barrier precaution (mask, gown, glove, sterile drapes).
Appropriate vein selection
Use of polyurethane catheter
Determine catheter type and size as appropriate
Perform skin antisepsis at the PICC site prior to placement and as part of routine site care
Assess the PICC insertion and/or exit site for signs and symptoms of infection
Push-pause technique while flushing
In-service education and training to nurses and caregivers
Develop specific PICC guidelines and prevention strategies in every PICC unit in the hospital
Prevent catheter dislodgement (partial or complete) through appropriate catheter securement
Check for incompatibility when 2 or more drugs/ solutions are infused together
Use chlorhexidine gluconate (CHG)-containing dressings to prevent unless contraindicated *(e.g.*, sensitivity or allergy to CHG)
Obtain paired blood samples for culture when CRBSI is suspected to definitively diagnose
Change transparent semi-permeable membrane (TSM) dressings at least every 7 days or immediately if the integrity of the dressing is compromised or if there is evidence of compromised skin integrity under the dressing

PICC, Peripherally Inserted central catheter; CHG, chlorhexidine gluconate; CRBSI, catheter-related bloodstream infection. Note. Interventions according to Nickel et al., 2024,[14] Brescia et al., 2024.[13]

In accordance with the 2024 Infusion Therapy Standards of Practice, the vein selection protocol prioritized the basilic vein of the right upper arm as the first-choice site for PICC insertion. This preference is based on its larger diameter and more direct anatomical course toward the central circulation, which reduces the risk of catheter malposition and mechanical complications.[2]

The diagnosis of Catheter-Related Bloodstream Infection (CRBSI) was defined according to the Centers for Disease Control and Prevention (CDC) guidelines.[15]

The study received no external funding and was classified as an observational prospective study by the local Ethics Committee of the Local Health Authority. Ethical approval was granted under protocol number DSA 11062023.

Results

The sample comprised patients who required the placement of a PICC for safety administration of fluids, chemotherapy, sedatives, antibiotics, and TPN. Table 2 displays the characteristics of the participants. Briefly, the sample (n=78) was predominantly male (55.1%), with a mean age of 79 years (SD = 16.43).

The types of devices managed by the VAT (n = 78) were non-tunneled, sutureless PICCs, all secured with stabilization devices and dressed using chlorhexidine-impregnated transparent film dressings. All implanted catheters were double-lumen, power-injectable PICCs made of high-strength polyurethane. Most catheters were 4 Fr (ICU n=46; oncology n=30); two ICU patients received 5 Fr catheters. The choice of catheter size was based on ultrasound-measured vein diameter, respecting a vein to PICC ratio > 3.[3] Double-lumen 5 Fr PICCs were used exclusively for patients requiring TPN.

The majority of PICCs were placed and managed in ICU (n=48). All PICCs remained in place during the study with a dwelling time of 3 months. PICCs were most inserted in the basilic vein (n=43) and in the right arm (n=60) according to the protocol, based on 2024 Infusion Therapy Standards of Practice.[2] The types of drugs administered were chemotherapy (38.5%), sedatives (14.1%), antibiotics (28.2%), fluids (16.7%), and Total Parenteral Nutrition (TPN) (2.5%). In the oncology setting, the PICCs were mainly used for the administration of chemotherapy drugs (n=26, 86.7%), while in ICU, PICCs have been used mainly for the administration of antibiotics.

Among the 78 PICCs included in our analysis, 5 of them developed CRBSI over 7020 catheter-days (6.4%, 0.71 per 1,000 catheter-days), 2 in ICU and 3 in oncology setting, leading to an infection rate of 0.46 per 1,000 catheter-days in ICU and 1.14 per 1,000 catheter-days in oncology. Infections were caused by coagulase-negative staphylococci (n=3) and staphylococcus aureus

Table 2. Characteristics of the sample and differences among those in ICU and oncology setting.

Characteristics	N (%) or m (SD), range	ICU settings(n=48) N (%) or m (SD), range	Oncology settings (n=30) N (%) or m (SD), range
Male	43 (55.1)		
Age (years)	79.04 (16.43) [47–95]		
Access type			
PICC	78 (100)	48 (100)	30 (100)
PICC characteristics			
Duration of PICC use (days)	7020 (100)	4380 (100)	2640 (100)
Number of lumens (Two)	78 (100)	48 (100)	30(100)
PICC gauge/thickness(French)			
4Fr	76 (97.4)	46 (95.8)	30 (100)
5Fr	2 (2.6)	2 (4.2)	
Arm of PICC insertion			
Right	60 (76.9)		
Left	18 (23.1)		
Vein of PICC insertion			
Basilic	43 (55.1)		
Cephalic	22 (28.2)		
Other	13 (16.7)		
Primary indication for PICC inser-tion			
Chemotherapy	30 (38.5)	4 (8.3)	26 (86.7)
Sedatives	11 (14.1)	11 (22.9)	
Antibiotics	22 (28.2)	21 (43.8)	2 (6.7)
Fluids	13(16.7)	10 (20.8)	2 (6.7)
Total parenteral nutrition	2 (2.5)	2 (4.2)	
Complications			26 (86.7)
Absent	71 (91)	45 (93.8)	3 (10)
CRBSI	5 (6.4)	2 (4.2)	1 (3.3)
Venous thrombosis	2 (2.6)	1 (2)	
CRBSI Pathogen			
Coagulase-negative staphylococci	3 (60)		
Staphylococcus aureus (MRSA)	2 (40)		

SD, Standard deviation; PICC, Peripherally Inserted central catheter; ICU, Intensive Care Unit; CRBSI, Catheter-Related Bloodstream Infection; Fr, French; MRSA, Methicillin-Resistant Staphylococcus Aureus.

(n=2). Among the 78 PICCs examined, 2 of them developed venous thrombosis (n=1 in ICU an n=1 in oncology), leading to a thrombosis rate of 0.28 per 1,000 catheter-days.

Discussion

The observed complication rates were lower than those reported in the literature, suggesting that a team-based approach to vascular access management may improve patient outcomes.[1,12,13,16]

This is consistent with contemporary evidence showing that hospital-based VATs enhance bundle adherence and patient safety, with measurable effects on device-related outcomes.

VAT implementation enables adherence to evidence-based protocols, including ultrasound-guided insertion, appropriate vein selection based on the catheter-to-vein ratio, standardised dressing procedures and consistent follow-up care.[2,12,14] Nurse specialists in VATs usually have advanced training and certifications, which ensures high procedural competence and reduces the number of insertion attempts and manipulation. These factors are known to decrease the risk of CRBSI and thrombosis.[6,8,10]

In our study, the incidence of CRBSI was 0.46 per 1,000 catheter-days in ICU and 1.14 per 1,000 catheter-days in the oncology setting. In a prospective observational study, the incidence of CRBSI was 6.25% (5.5 per 1,000 days of PICC), 1.39% (1.2 per 1,000 days) in those admitted to an ICU setting, and 4.86% (4.2 per 1,000 days) in those linked to the non-ICU group.[5] In another prospective study carried out at a single cancer institution on 291 PICC placement for chemotherapy, the occurrence of venous thrombosis was recorded at 4.1%, while catheter dislodgment was observed at a rate of 3.8%.[3]

Our oncology CRBSI rate is directionally in line with cancer cohorts where chemotherapy and immunosuppression increase vulnerability to device-related infection.[17]

The variation observed in our sample between ICU and oncology settings may be due to differences in organisational structure, patient profiles and continuity of care. ICU patients benefit from close monitoring, high nurse-to-patient ratios and rapid access to interventions, all of which facilitate the early detection of complications.[5,11] In contrast, oncology patients often receive intermittent therapies across inpatient and outpatient settings, which increases line manipulations and reduces surveillance continuity, two factors associated with a higher risk of complications.[18,19] Furthermore, immunosuppression in cancer patients due to chemotherapy or the underlying disease has been independently associated with higher CRBSI rates,[18,19] a trend that is reflected in our findings. In particular, Haddad *et al.* highlights neutropenia, multiple prior catheters and intensive treatment burden as key risk factors for CRBSI in high-risk cancer patients, supporting our interpretation of setting-related differences.[18]

In terms of thrombosis, our study found an incidence rate of 2.6% (0.28 per 1,000 catheter days). This compares favourably with the rates reported by Bertoglio *et al.*[3] in oncology patients (4.1%) and in a large Spanish cohort (2.01%).[20]

No catheter dislodgement events occurred in our study, whereas previous reports have shown dislodgement rates ranging from 5% to 31%[21,22] supporting the hypothesis that structured maintenance and securement protocols play a preventive role.[23]

Similarly, a multicentre study demonstrated that the presence of hospital-based VATs was associated with better adherence to insertion bundles and improved patient safety.[24] Furthermore, VATs have been found to reduce total costs by minimising complications and shortening hospital stays.[10,11]

The most frequently implicated organisms in catheter-related infection remain coagulase-negative staphylococci and Staphylococcus aureus, alongside Gram-negative bacilli (e.g., *Enterobacterales*, *Pseudomonas*) and *Candida* spp., reinforcing the dual importance of skin-flora control and rigorous maintenance practices.[15,19] This microbiological profile supports our emphasis on insertion bundles, securement, and line-handling discipline within VAT models.[13,14,24] Our zero-dislodgement finding aligns with recent evidence: in adult oncology, tunnelled PICCs reduce dislodgement versus conventional PICCs (4.7% vs 10.1%; p=0.01) in a multicentre RCT,[25] and a 2024 meta-analysis of 12 RCTs (n=2940) shows a two-thirds risk reduction (OR 0.33; 95% CI 0.22–0.50).[26] These positive outcomes may be attributed to several key factors: the use of a standardized protocol, management by a specialized team, and the absence of drop-outs over the 3 months period. Despite these encouraging results, the study has some limitations. It was conducted in only two hospitals, and the relatively small sample size limited the statistical power of the analysis. However, the sample was representative of the ICU and oncology populations within the organisation. Nevertheless, it may still reflect specific clinical characteristics that limit extrapolation to other contexts. There was also no control group available for direct comparison. Furthermore, patients were not stratified based on individual risk factors (e.g. neutropenia or previous catheter use) and outcomes were not assessed beyond three months. A key limitation is the small number of events (five CRBSIs and two venous thromboses), which yields imprecise proportion estimates and limits inferential precision. The results should therefore be interpreted as exploratory and confirmed in larger samples. These factors limit the generalisability of the results to broader populations or non-VAT contexts. Further randomised controlled trials and multicentre studies are needed to evaluate the full impact of VAT-led management models, including a comparison arm (VAT-led *vs* non-VAT management). In particular, studies should explore these differences across various care settings, such as emergency departments, long-term care facilities, and surgical units, and among different patient populations, including pediatric, oncologic, and critically ill patients. These should assess both clinical outcomes (e.g., infection rates, catheter dwell time, complication rates) and organisational indicators (*e.g.,* procedure efficiency, cost-effectiveness).

Conclusions

At three months' follow-up, the incidence of complications among patients managed by a nurse-led vascular access team (VAT) was 9%, including catheter-related bloodstream infections (6.4%; 0.71 per 1,000 catheter-days) and venous thrombosis (2.6%; 0.28 per 1,000 catheter-days). These relatively low complication rates may be associated with the implementation of standardized insertion and maintenance protocols, continuous staff training, and quality monitoring led by the VAT. While findings are limited by the sample size and the single-country setting, they highlight the potential clinical and organizational value of structured VAT models, particularly in high-complexity areas such as ICUs and oncology units. Broader adoption of vascular access teams, supported by targeted policy and educational initiatives, could contribute to improved patient safety and resource optimization in vascular access management. We recommend implementing and extending nurse-led VATs in high-complexity settings, based on standardised protocols, competency-based training, routine monitoring, and outcome tracking.

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