Successful Unconventional Treatment of Serratia Marcescens Exit-Site Infection in a Central Venous Catheter for Hemodialysis: A Case Report

Nefrologo in corsia

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ABSTRACT

Introduction. Central Catheter-related infections and biofilm formation are significant issues in the context of nosocomial infections that increase resistance to conventional therapies.

Methodology. This case report describes an unconventional treatment for a Serratia Marcescens Central Venous Catheter infection in a hemodialysis patient through the combination of polyguanide and betaine. Clinical evaluations were conducted using the Visual Exit-Site Score and culture swabs.

Results. After the first four treatment sessions there was a significant reduction in redness and pain (VES=1); the culture swab at the end of treatment was negative.

Conclusions. The results of this case report encourage further research on the effectiveness of non-antibiotic treatments.

KEYWORDS: Exit-Site infection, Central Venous Catheter, Serratia Marcescens, Polyguanide, Betaine

Introduction

The increasing global incidence of chronic kidney disease (CKD) [1] underscores the importance of hemodialysis as a life-saving replacement therapy. In this context, the use of central venous catheters (CVCs) introduces significant risks, including the onset of infections at the exit site [2]. These infections, often caused by resistant pathogens like Serratia Marcescens, pose major challenges, affecting patients' quality of life and prognosis [3, 4]. Catheter-related infections (CRIs) are a significant issue in healthcare, with biofilms providing microorganisms a protective environment, increasing resistance to conventional therapies. Studies show that 50-70% of microbial infections involve biofilms emphasizing the need for effective treatments [5]. As microbial resistance rises, researching alternatives to traditional antibiotics is crucial [6]. This case report outlines the phases and management of an innovative treatment for a Serratia Marcescens infection in a hemodialysis patient using polyguanide and betaine. This promising approach aims to enhance current clinical practices in managing CVC infections and offers a new strategy for CRIs caused by Serratia Marcescens.

Case Report

The patient, a 73-year-old woman with chronic kidney disease (CKD), type II diabetes, diabetic retinopathy, hypertension, arterial stenosis, angiosclerosis, and osteomyelitis, was under nephrology care. In March 2022, she was hospitalized for ventricular heart failure and acute kidney injury (AKI) stage 3 per AKIN criteria, and CKD stage G4 per KDIGO guidelines. She underwent dialysis for ultrafiltration via a CVC initially in the right femoral vein, later switched to a tunneled CVC in the right internal jugular vein. By January 2023, she showed symptoms of redness, pain, and purulent discharge at the CVC exit site, suggesting an infection. To address this, she was enrolled in an integrated treatment protocol to reduce or resolve the infection.

Ethics

The study followed Good Clinical Practice [7] and the Declaration of Helsinki. Ethics approval wasn't needed as it was retrospective. The patient provided written informed consent for participation and data processing. All personal information was anonymized to protect privacy according to ethical guidelines.

Treatment

The treatment commenced with an initial evaluation of the exit-site of the CVC, utilizing the Visual Exit-Site (VES) [8, 9] score. This tool provides a visual assessment to determine the severity of CVC exit-site infection and guide intervention. The score ranges from 0 to 3, indicating increasing severity, as depicted in Figure 1.

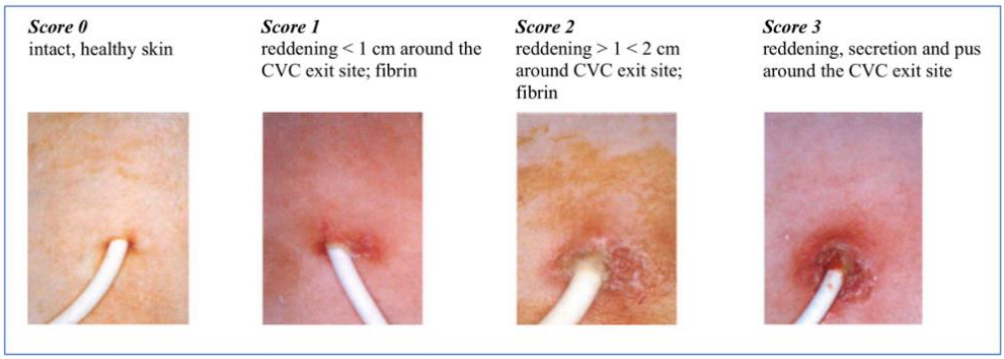

Figure 1. Exit-site infection score [9].

The patient received a VES score of three, indicating moderate infection severity. Culture swab results confirmed Serratia Marcescens, known for its resistance and treatment difficulty, necessitating a targeted therapeutic approach. Despite the local infection, blood tests showed normal white blood cell (WBC) count ($9.13 \times 10^3/mm^3$) and C-reactive protein (CRP) (20.6 mg/L), and the patient had no fever (36.5°C), suggesting no systemic infection.

In agreement with the medical team, we chose a local treatment for the catheter exit-site, avoiding systemic antibiotics due to the patient's comorbidities. This cautious approach involved close monitoring for signs of systemic infection.

Given the antibiotic resistance concerns and the pathogen's characteristics, we selected an unconventional treatment using polyguanide and betaine for their antimicrobial properties and effectiveness against biofilm formation. The regimen included topically applying of a 1% Polyguanide and Betaine gel and solution (ProntosanÒ Wound Gel X; ProntosanÒ Solution) followed by a silver hydrofiber [10] dressing (Aquacel™ ag + extra™) (Supplementary File 1 shows details on dosage compositions) for its antimicrobial and anti-inflammatory benefits. According to our decision tree, the protocol for a VES score of three led to a series of targeted procedures described in two phases.

Phase 1

Phase 1 starts with removing the old dressing and evaluating inflammation signs. A gauze soaked in polyguanide and betaine is applied for 15 minutes, then removed, and the area is gently cleansed. A silver hydrofiber dressing and non-woven fabric patch are applied to combat exudate, infection, and biofilm. This process repeats for four sessions.

Phase 2

Phase 2 involves reassessment. If VES score decreases or symptoms improve, polyguanide and betaine compresses continue without the silver hydrofiber dressing; otherwise, treatment extends for four more sessions.

Results

After three medication sessions with a polyguanide and betaine, the patient reported reduced itching, but pain and redness persisted. Phase 1 treatment was then augmented. After one month, the VES score decreased to 2, but Serratia Marcescens persisted. Blood tests showed normal WBC ($7.34 \times 10^3/mm^3$) and CRP (18.7 mg/L). Given the improvement, treatment was extended for six more sessions, reducing the VES score to 1.

At the end of the second month, the VES score further decreased, and culture swabs were negative. The patient then transitioned to the standard exit-site disinfection protocol with 2% chlorhexidine, the gold standard for vascular access disinfection [7], providing enhanced protection against CRIs as confirmed by a recent RCT [8]. Figure 2 shows the evolution of the VES score, pain, and itching, while Figure 3 illustrates the clinical course.

The experimental protocol showed gradual symptomatic improvement, monitored using the VES score and image archiving. Figure 4 illustrates the healing progression of the CVC exit-site. Images 1 to 4 depict resolution from severe infection to treatment outcome.

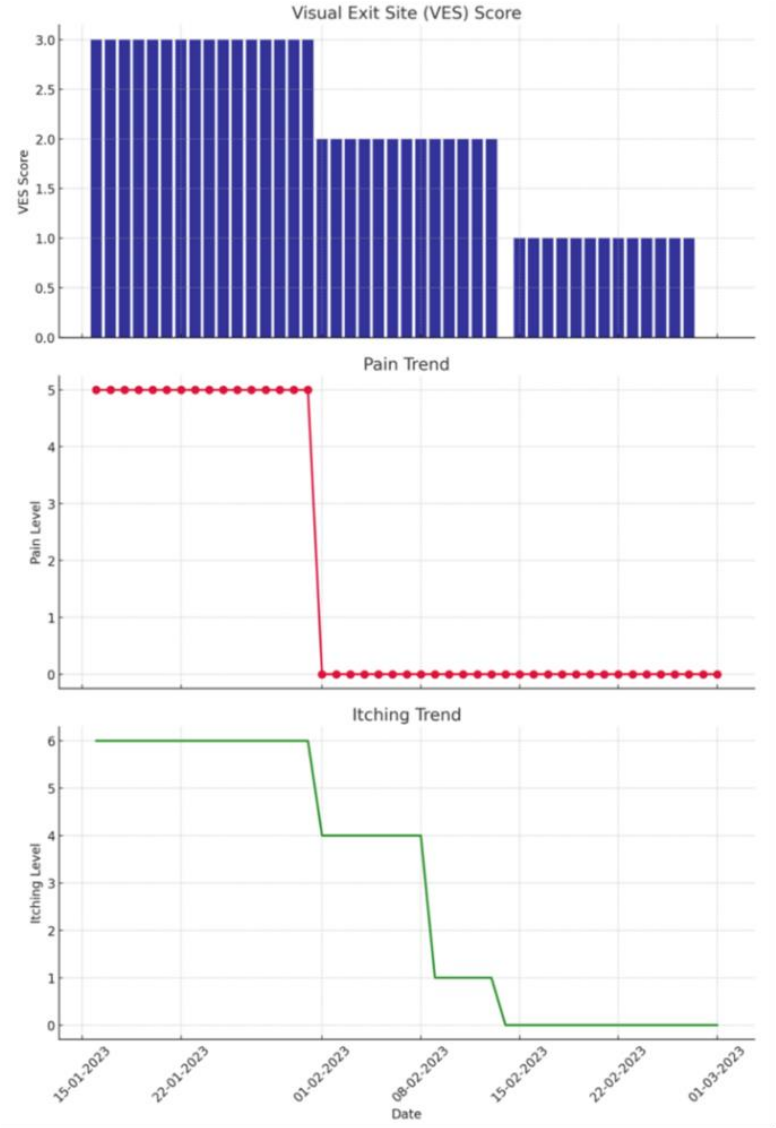

Figure 2. Visual Exit-Site Score, Pain and Itching trend.

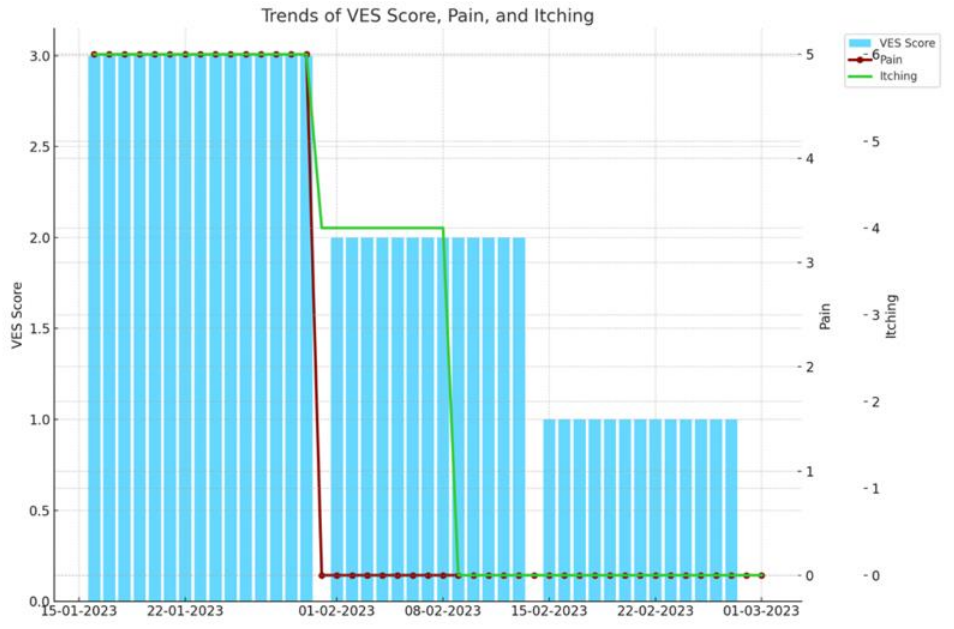

Figure 3. Overall representation of the patient's clinical course related to CVC exit-site infection.

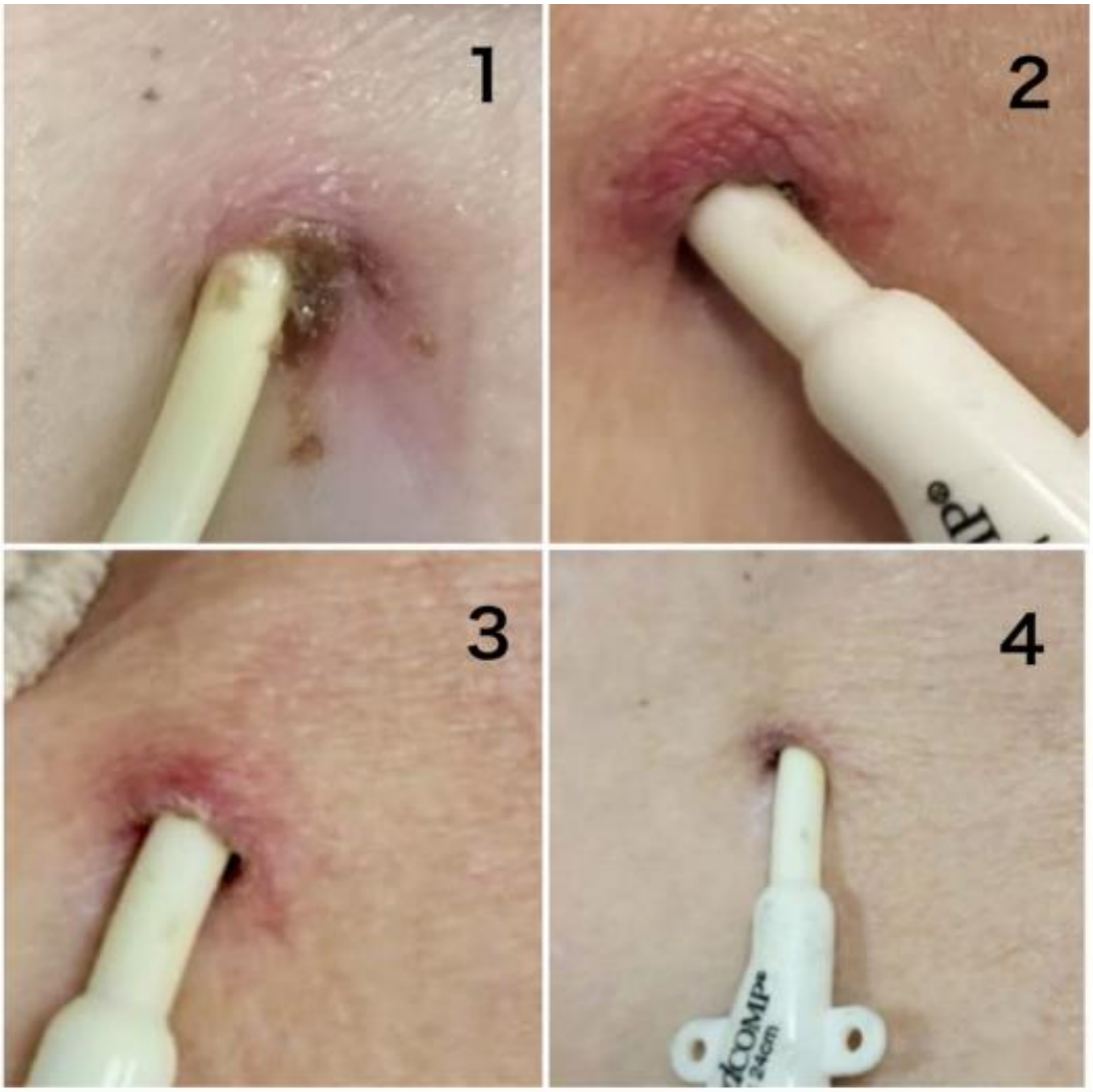

Figure 4. Progression of CVC exit-site healing. 1: Initial state showing clear signs of infection and inflammation; 2: Improvement after the initial stages of treatment, with a reduction in redness and discharge; 3: Continued reduction of inflammation and visible signs of healing; 4: Healing of the exit-site with minimal residual signs of inflammation.

Discussion

This case study detailed a CVC exit-site infection caused by Serratia Marcescens, effectively treated with a non-antibiotic regimen of polyguanide and betaine. This approach addresses the escalating challenge of antimicrobial resistance, as noted by Opal et al. [11], and is supported by Suleman et al.'s findings on the efficacy of silver dressings in combating biofilms, including those of Serratia Marcescens [12].

The use of polyguanide is notable for its highly effective antimicrobial properties at low concentrations and lack of inducing therapeutic resistance. Compared to standard treatments like chlorhexidine and povidone-iodine, polyguanide's superior skin tolerance is confirmed by biocompatibility analyses by Batra L. et al. [13], Mueller G. [14] and Koburger T. et al. [15]. These factors, coupled with the absence of systemic infection signs, justified avoiding systemic antibiotics for a targeted approach with reduced side effects. The approach adopted in this clinical case highlighted the importance of holistic and personalized care, aligning with patient-centered nursing care recommendations by Isvoranu et al. and Hilbrands et al [16, 17]. This regimen improved patient

compliance, alleviated anxiety, and enhanced clinical outcomes and quality of life, as supported by Juanamasta et al. [18].

Our integrated CVC management protocol, utilizing tools like the VES score and a decision tree, improved early diagnosis and treatment. This standardization, supported by Safdar et al. [19] and Roderman N. et al. [20], increased the quality of care delivered, and reduced variability in clinical decisions, enhancing patient outcomes, as shown by Cobo-Sanchez [4].

This successful outcome underscores the value of innovative, patient-centered treatment strategies, improving quality of life beyond infection control. Further research into non-antibiotic treatments and holistic care for CKD patients undergoing dialysis is encouraged.

Strengths and limitations

This case report highlights the effectiveness of a non-antibiotic regimen for managing specific CVC infections, crucial in an era of increasing antibiotic resistance. Careful monitoring and treatment adaptation successfully addressed the infection without systemic drugs, demonstrating that a strategic approach can yield positive outcomes.

Despite promising results, this single-patient case report limits generalizability. The suitability of the polyguanide and betaine combination for all CVC-related infections is uncertain, necessitating additional research across diverse patient populations to validate its effectiveness.

Conclusions

This case report highlights an innovative non-antibiotic approach to treating a Serratia Marcescens infection in a CVC patient, utilizing the polyguanide and betaine combination as an effective alternative for resistant pathogens. Standardized practices, like the VES Score and decision tree, enhance care and outcomes, while rapid symptom improvement underscores the value of holistic, personalized care. Further research on non-antibiotic treatments and holistic care is warranted for broader clinical use.

PRODUCT	ACTIVE INGREDIENTS	DOSAGE
Prontosan Wound Gel X	Polyaminopropyl Biguanide	0.50 g/100 g of product
	Undecylenamidopropyl Betaine	0.35 g/100 g of product
	Hydroxyethylcellulose	3.10 g/100 g of product
	Glycerol	8.60 g/100 g of product
Prontosan Solution	Polyaminopropyl Biguanide	0.10 g/100 g of product
	Undecylenamidopropyl Betaine	0.10 g/100 g of product
Aquacel Ag + Extra	Hydrocolloid fibers of pure Sodium Carboxymethylcellulose with Silver Ions	1.2% by dressing weight
	Ethylenediaminetetraacetic acid (EDTA)	0.35% by dressing weight
	Benzethonium Chloride	0.125% by dressing weight

Supplementary table. Products' dosage and compositions.

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