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Uremic Frost: Cutaneous Messages of Renal Dysfunction—Case Report and Brief Review

Cristian Alberto Lobo-Ardila[1,2], María José Vargas-Fierro[2,3], Laura Vanessa Triviño-Blanco[2,4], Kendry Yulieth Arrieta-Iguarán[2,5], Paula Andrea Orozco-Ochoa[2,6], Maria Alexandra Oñate-Lanao[2,6], Oscar Andres Vargas-Fierro[2,7]

[1]General Practitioner, Juan N. Corpas University, Bogotá, Colombia
[2]Department of Internal Medicine, AvanceMed—Independent Research Group in Internal Medicine, Bogotá, Colombia
[3]Health Sciences Department, Pontificia Javeriana University, Bogotá, Colombia
[4]Health Sciences Department, Universidad del Rosario, Bogotá, Colombia
[5]Health Sciences Department, Universidad del Sinú, Cartagena, Colombia
[6]Health Sciences Department, University of Cartagena, Cartagena, Colombia
[7]Health Sciences Department, Fundación Universitaria Navarra, Neiva, Colombia
Email: cristianlobo@msn.com, mariajose.vargasfierro@outlook.es, mementovivere0@gmail.com, Kendry15arrieta16@hotmail.com, Paulaorozco8a@gmail.com, mariaonate02@gmail.com, oscarvf0810@gmail.com

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Abstract

Uremic frost is an uncommon dermatologic manifestation classically associated with advanced chronic kidney disease (CKD), resulting from the cutaneous deposition of urea crystals and other nitrogenous compounds secondary to severe uremia. Although it has become increasingly rare because of earlier CKD diagnosis and timely access to kidney replacement therapy, its recognition remains of considerable clinical importance, particularly in emergency settings or in patients with previously undiagnosed disease or limited access to healthcare. Clinically, it is characterized by the presence of fine, adherent, whitish plaques or deposits on the skin surface, reflecting a critically disturbed metabolic state. We report the case of a 72-year-old man with advanced systemic deterioration, poor general condition, and whitish cutaneous lesions consistent with uremic frost, in whom this finding represented a visible manifestation of severe organ failure in the setting of advanced uremia. The patient's clinical course rapidly deteriorated, resulting in death shortly thereafter. This case highlights the importance of recognizing cutaneous manifestations as indicators of severe systemic disease and underscores the need for prompt, comprehensive evaluation, as these findings may provide valuable diagnostic clues in critically ill patients.

Keywords

Chronic Kidney Disease, Uremia, Skin Diseases, Kidney Replacement Therapy

1. Introduction

Chronic kidney disease (CKD) is a progressive disorder with a high prevalence and an increasing impact on healthcare systems worldwide. It is estimated that approximately 10% of the adult population has some degree of kidney dysfunction, with prevalence continuing to rise because of population aging and the growing burden of chronic noncommunicable diseases such as type 2 diabetes mellitus and hypertension, the principal risk factors for its development [1]. CKD not only impairs renal excretory function but also causes alterations in multiple organs and systems, including the integumentary system, resulting in a wide range of dermatologic manifestations with potentially important diagnostic and prognostic implications [2] [3].

Cutaneous manifestations in patients with CKD may be related to the underlying etiology of kidney disease, metabolic complications secondary to uremia, or the direct effects of kidney replacement therapy, including hemodialysis and peritoneal dialysis [4] [5]. Common dermatologic findings include uremic pruritus, xerosis, skin hyperpigmentation, and calciphylaxis [6]-[8]. However, one manifestation that has become exceedingly rare in contemporary clinical practice is uremic frost, a condition resulting from the transdermal accumulation of nitrogenous waste products that crystallize on the skin surface [9]-[11].

This clinical phenomenon, also known as "crystallized uridrosis", was first described by Dr. Harald Hirschsprung in 1865 and has since been regarded as a finding indicative of untreated end-stage kidney disease. Its recognition should alert clinicians to the presence of severe uremia and the urgent need to initiate kidney replacement therapy [4] [9] [10]. The marked decline in its incidence over recent decades reflects advances in the early diagnosis and timely management of CKD [2] [4]. Nevertheless, cases such as the one presented here, in which uremic frost constitutes a visible sign of systemic decompensation, underscore the importance of maintaining clinical awareness of this distinctive finding. We report a clinical case illustrating this rare yet highly characteristic dermatologic manifestation of advanced CKD.

2. Case Presentation

A 72-year-old man was brought to the emergency department by a family member because of progressive deterioration in his general condition. During the 24 hours preceding admission, he developed worsening functional decline, marked somnolence, disorientation, and progressive impairment of consciousness. His medical history was significant for hypertension of approximately 10 years' duration, with

poor adherence to treatment with losartan 50 mg twice daily. He had not received medical follow-up during the previous three years, and there was no documented history of chronic kidney disease. Consequently, at presentation, it was not possible to determine with certainty whether the patient's renal dysfunction represented acute kidney injury (AKI), previously undiagnosed chronic kidney disease (CKD), or AKI superimposed on CKD. However, given his long-standing, poorly controlled hypertension, hypertensive nephrosclerosis leading to underlying CKD was considered the most likely etiology.

On admission, the patient was hemodynamically unstable, with a blood pressure of 86/54 mmHg, heart rate of 116 beats/min, respiratory rate of 26 breaths/min, and oxygen saturation of 88% on room air. Physical examination revealed a diffuse ichthyosiform dermatosis predominantly involving the trunk, lower extremities, axillae, abdomen, and pubic region, characterized by dry, fine, adherent whitish scales covering the skin surface (Figure 1). In the setting of severe uremia and the absence of previous kidney replacement therapy, these findings were highly suggestive of uremic frost. Although skin scrapings and chemical analysis of the deposits could not be performed because these tests were unavailable, the morphology and distribution of the lesions, together with the clinical and biochemical findings, strongly supported the diagnosis.

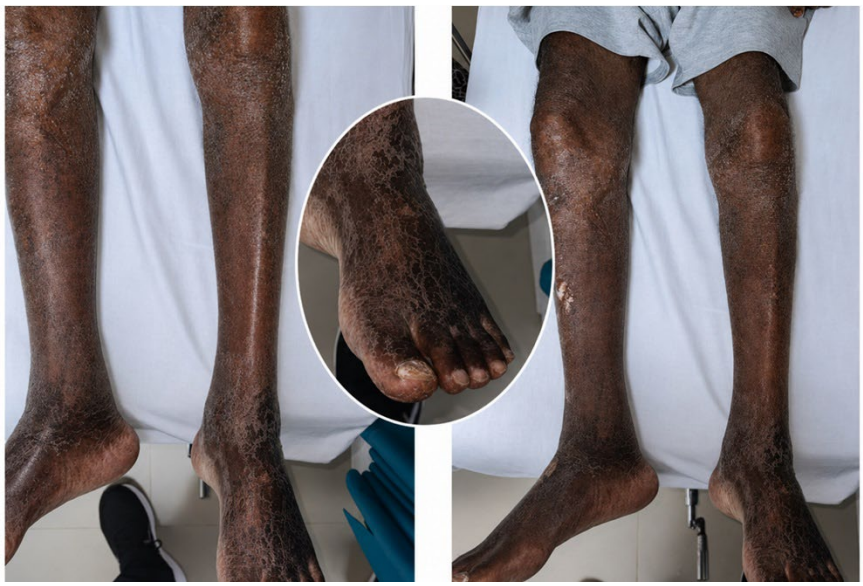

Figure 1. Dry, adherent whitish cutaneous deposits overlying hyperpigmented, xerotic skin on both lower extremities, with predominant distal involvement, consistent with uremic frost.

Laboratory investigations revealed abnormalities consistent with end-stage chronic kidney disease, including markedly elevated serum creatinine and blood urea nitrogen levels, hyperkalemia, hyperphosphatemia, and severe metabolic acidosis associated with hyperlactatemia. Additionally, the patient had World Health Organization (WHO) grade II anemia, thrombocytopenia, and a

total leukocyte count within the normal range with relative neutrophilia (Table 1).

Table 1. Laboratory findings at the time of admission to the emergency department.

Category	Parameter	Result	Interpretation
Renal function	Serum creatinine	12 mg/dL	Severe elevation, consistent with advanced kidney failure
	Blood urea nitrogen (BUN)	210 mg/dL	Markedly elevated
Electrolytes and mineral metabolism	Serum potassium	6.4 mmol/L	Hyperkalemia
	Serum phosphorus	7.0 mg/dL	Hyperphosphatemia
Acid–base status	pH	7.15	Severe metabolic acidosis
	$PaCO_2$	21 mmHg	Compensatory decrease
	Lactate	3.1 mmol/L	Elevated
Hematologic profile	Hemoglobin	8.2 g/dL	WHO grade II anemia
	Platelet count	$89 \times 10^3/\mu L$	Thrombocytopenia
	White blood cell count	$10.5 \times 10^3/\mu L$	No leukocytosis
	Neutrophils	$7.46 \times 10^3/\mu L$ (71%)	Relative neutrophilia*
	Lymphocytes	$2.31 \times 10^3/\mu L$ (22%)	Within normal limits
	Eosinophils	$0.11 \times 10^3/\mu L$ (1%)	Within normal limits
	Monocytes	$0.21 \times 10^3/\mu L$ (2%)	Within normal limits
	Basophils	0%	Within normal limits

Despite initial stabilization measures, including interventions to correct hyperkalemia, supportive management in the intensive care unit, and vasopressor support with norepinephrine, kidney replacement therapy could not be initiated within a clinically meaningful timeframe. The patient subsequently developed progressive neurological and metabolic deterioration and died 48 hours after admission. In this case, although rarely encountered in contemporary clinical practice, the dermatologic finding served as a key clinical indicator of previously unrecognized severe uremia and underscored the severity of the underlying systemic illness.

3. Discussion

Uremic frost is one of the rarest yet most distinctive cutaneous manifestations of end-stage chronic kidney disease. Its occurrence reflects severe uremia and results from the transepidermal excretion of urea and other nitrogenous waste products through sweat [10]. Following evaporation of the aqueous component, these solutes precipitate and crystallize on the skin surface, forming a dry, adherent, whitish layer resembling frost or salt [4] [9]. This phenomenon is typically observed in the setting of marked azotemia, generally when blood urea nitrogen concentrations reach extremely high levels, facilitating the diffusion of urea into the sweat

glands [4] [9] [10].

In contemporary clinical practice, uremic frost has become exceedingly uncommon owing to earlier diagnosis of chronic kidney disease and greater availability of kidney replacement therapy [4]. Nevertheless, it may still occur in patients with previously undiagnosed disease, inadequate medical follow-up, poor treatment adherence, or limited access to healthcare services [5]. Clinically, it is often associated with severe xerosis, pruritus, and adherent whitish plaques or scales, most commonly involving intertriginous areas but also affecting the trunk, face, and extremities. In this context, its recognition should be regarded as a clinical marker of advanced metabolic derangement rather than an isolated dermatologic finding [4] [9]-[11].

The diagnosis is primarily clinical and relies on the correlation between the characteristic cutaneous findings and the biochemical evidence of severe uremia, as observed in our patient. Although confirmation can be obtained by skin scraping followed by crystal analysis demonstrating a high urea content, this approach is rarely required in routine clinical practice [10]. The differential diagnosis includes ichthyosiform dermatoses, psoriasis, pityriasis alba, and certain superficial cutaneous infections, making integration of the dermatologic findings with the overall clinical context essential [4].

Management should focus on the underlying cause rather than the cutaneous manifestation alone. Accordingly, kidney replacement therapy, either hemodialysis or peritoneal dialysis depending on resource availability and the patient's clinical condition, remains the cornerstone of treatment [2] [10]. Adjunctive measures, including topical emollients, pruritus control, and general supportive care, may improve patient comfort while definitive therapy is initiated. Failure to institute timely treatment may result in rapid metabolic and hemodynamic deterioration, leading to fatal outcomes, as occurred in the present case. Therefore, despite its rarity, uremic frost retains considerable clinical significance as a warning sign of advanced uremia and a potential medical emergency [2] [4] [10] [11].

4. Conclusion

Although uncommon, uremic frost remains an important diagnostic marker of severe uremia, particularly in patients with limited access to healthcare or inadequate follow-up of chronic diseases. In the present case, its recognition was instrumental in establishing the diagnosis of previously unrecognized end-stage chronic kidney disease. The patient's rapidly fatal clinical course underscores the need to strengthen strategies for the early detection of chronic kidney disease and to ensure timely access to kidney replacement therapy. Furthermore, this case highlights the importance of recognizing cutaneous manifestations as clinical indicators of severe systemic disease and maintaining a high index of suspicion when evaluating unusual dermatologic findings in patients at risk of kidney dysfunction.

AI-Assisted Tool Disclosure

AI was used to assist with the language polishing of this manuscript, improving its fluency and clarity of expression.

Author Contributions

Contribution	Authors
Conceptualization	Cristian Alberto Lobo-Ardila, María José Vargas-Fierro, Oscar Andres Vargas-Fierro
Methodology	Cristian Alberto Lobo-Ardila, María José Vargas-Fierro, Oscar Andres Vargas-Fierro, Laura Vanessa Triviño-Blanco
Validation	All the authors
Formal analysis	Cristian Alberto Lobo-Ardila, María José Vargas-Fierro, Kendry Yulieth Arrieta-Iguarán
Investigation	Kendry Yulieth Arrieta-Iguarán, Paula Andrea Orozco-Ochoa, Maria Alexandra Oñate-Lanao
Data curation	Cristian Alberto Lobo-Ardila, Laura Vanessa Triviño-Blanco, Kendry Yulieth Arrieta-Iguarán
Writing Original Draft	Cristian Alberto Lobo-Ardila, María José Vargas-Fierro, Laura Vanessa Triviño-Blanco, Kendry Yulieth Arrieta-Iguarán, Paula Andrea Orozco-Ochoa, Maria Alexandra Oñate-Lanao
Writing Review & Editing	Cristian Alberto Lobo-Ardila, María José Vargas-Fierro, Oscar Andres Vargas-Fierro
Visualization	Cristian Alberto Lobo-Ardila
Supervision	Oscar Andres Vargas-Fierro

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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