ORIGINAL RESEARCH

Study of Skin Manifestations in Patients with Chronic Kidney Disease Undergoing Dialysis

[1]Dr. Indu Ballani, [2]Dr. Saurabh Kansal

[1]Associate Professor, Department of Dermatology, Major S D Singh Medical College & Hospital, Farrukhabad, India
[2]Associate Professor, Department of General Medicine, Saraswathi Institute of Medical Sciences, Hapur, India

Corresponding Author
Dr. Saurabh Kansal
Associate Professor, Department of General Medicine, Saraswathi Institute of Medical Sciences, Hapur, India

Received: 22 April, 2014 Accepted: 25 May, 2014

ABSTRACT

Aim: The aim of this study was to evaluate the prevalence, types, and associated factors of skin manifestations in patients with chronic kidney disease (CKD) undergoing maintenance hemodialysis. **Material and Methods:** This observational, cross-sectional study was conducted on 100 CKD patients undergoing maintenance hemodialysis at a tertiary care hospital. Patients aged ≥18 years, with CKD Stage 5 undergoing hemodialysis for at least six months, were included. Comprehensive dermatological examinations were conducted, and skin manifestations were classified. Laboratory parameters, including serum urea, creatinine, calcium, phosphorus, parathyroid hormone (PTH), hemoglobin, and albumin levels, were analyzed. Data were statistically evaluated using SPSS version 16.0 to determine prevalence and associations. **Results:** Skin manifestations were highly prevalent, with xerosis (78%), pruritus (64%), and hyperpigmentation (52%) being the most common. Significant associations were observed between xerosis and low albumin ($p < 0.01$), pruritus and elevated phosphorus ($p < 0.05$), and nail changes with elevated PTH levels ($p < 0.01$). Laboratory analysis revealed elevated phosphorus (mean: 6.1 ± 1.4 mg/dL) and PTH levels (mean: 450 ± 200 pg/mL), as well as low hemoglobin (mean: 9.2 ± 1.8 g/dL) and albumin levels (mean: 3.4 ± 0.5 g/dL). Logistic regression identified hypoalbuminemia, elevated phosphorus, and longer dialysis duration as key predictors of skin manifestations. **Conclusion:** This study highlights the significant burden of skin manifestations in CKD patients undergoing dialysis, emphasizing their association with biochemical imbalances and poor nutritional status. Early recognition and targeted management of these conditions are essential for improving patient outcomes and quality of life.

Keywords: Chronic kidney disease, Hemodialysis, Skin manifestations, Xerosis, Pruritus

INTRODUCTION

Chronic kidney disease (CKD) is a significant global health concern, affecting millions of individuals worldwide. As CKD progresses to end-stage renal disease (ESRD), patients often require dialysis to sustain life. Hemodialysis, the most common modality of renal replacement therapy, significantly improves survival rates but is associated with a range of systemic complications, including notable skin manifestations. The skin, being one of the most visible and accessible organs, frequently reflects the underlying systemic disturbances of CKD. These cutaneous changes can profoundly impact a patient's quality of life, contributing to physical discomfort, emotional distress, and social challenges.[1]The pathophysiology of skin changes in CKD is multifactorial, involving a complex interplay of uremic toxins, metabolic disturbances, impaired immune function, and vascular alterations. As kidney function deteriorates, the accumulation of uremic toxins leads to systemic effects, including alterations in skin structure and function. Dialysis itself, though lifesaving, introduces additional factors such as electrolyte imbalances, vascular access complications, and prolonged exposure to dialysis membranes, which can exacerbate skin-related issues.[2] Skin manifestations in CKD patients are diverse, ranging from pruritus and xerosis to more severe conditions such as calciphylaxis. Xerosis, or dry skin, is one of the most common dermatological complaints in this population. It often results from reduced sebaceous and sweat gland activity due to autonomic dysfunction. Pruritus, another prevalent symptom, is not only uncomfortable but can lead to secondary complications such as excoriations, infections, and sleep disturbances. This itching is believed to be linked to uremic toxins, secondary hyperparathyroidism, and an imbalance of

pruritogenic mediators.[3] Hyperpigmentation and pallor are also frequently observed in CKD patients. Hyperpigmentation occurs due to the deposition of melanin in basal keratinocytes, often exacerbated by chronic anemia and increased production of parathyroid hormone. Pallor, on the other hand, is primarily a result of anemia, a common complication of CKD caused by decreased erythropoietin production and iron deficiency. Nail changes, including half-and-half nails (Lindsay's nails), reflect vascular changes and chronic systemic inflammation and are often considered diagnostic clues for CKD.[4,5] More severe dermatological conditions, such as calciphylaxis and metastatic calcification, represent life-threatening complications of CKD. Calciphylaxis involves vascular calcification and thrombosis, leading to painful skin ulcers and a high risk of secondary infections. This condition is strongly associated with an elevated calcium-phosphorus product and secondary hyperparathyroidism, both of which are common in patients undergoing dialysis. These serious manifestations highlight the need for vigilant monitoring and early intervention.[6] The high prevalence of skin manifestations in CKD patients undergoing dialysis is a reflection of the systemic nature of the disease and its treatment. These dermatological conditions can severely impair a patient's quality of life, contributing to physical symptoms, emotional distress, and social isolation. Addressing these manifestations requires a multidisciplinary approach, involving nephrologists, dermatologists, and nutritionists, to provide holistic care. Effective management strategies focus on identifying and addressing underlying causes, such as metabolic derangements and secondary infections, while alleviating symptoms to improve patient comfort and well-being.[7] Despite the prevalence and impact of skin conditions in CKD patients, their recognition and management are often underestimated in clinical practice. Many of these manifestations develop insidiously and are overshadowed by the focus on other systemic complications of CKD. However, early identification and intervention can significantly improve patient outcomes and quality of life. Educating healthcare providers and patients about these conditions is critical to ensuring timely diagnosis and treatment.[8] Skin manifestations in patients with CKD undergoing dialysis are a significant but often overlooked aspect of their clinical care. These conditions reflect the systemic effects of CKD and its treatment, ranging from common issues like xerosis and pruritus to life-threatening complications like calciphylaxis. Their impact on quality of life underscores the need for heightened awareness, early detection, and effective management. A comprehensive understanding of these dermatological manifestations and their underlying mechanisms is essential for improving outcomes and enhancing the overall care of CKD patients.

MATERIAL AND METHODS

This study was designed as an observational, cross-sectional study to assess the prevalence and types of skin manifestations in patients with chronic kidney disease (CKD) undergoing maintenance hemodialysis.The study was conducted on 100 patients diagnosed with CKD and undergoing regular hemodialysis at tertiary care hospital. Patients were selected based on the following inclusion and exclusion criteria:

Inclusion Criteria

- Age ≥ 18 years.
- Diagnosed with CKD (Stage 5) and undergoing maintenance hemodialysis for at least 6 months.
- Willingness to provide written informed consent.

Exclusion Criteria

- Patients with acute kidney injury.
- Patients with other systemic diseases that could independently affect the skin (e.g., autoimmune diseases, systemic lupus erythematosus).
- Patients on immunosuppressive therapy or with active dermatological infections.

Methodology

Data collection for the study involved multiple steps to ensure a comprehensive evaluation of skin manifestations in patients with chronic kidney disease undergoing dialysis. A detailed clinical history was obtained from all participants, covering the duration of CKD, the length and frequency of dialysis treatments, the presence of comorbid conditions such as diabetes and hypertension, and any prior or ongoing skin-related complaints. A thorough dermatological examination was conducted under proper lighting by a qualified dermatologist to identify and classify skin manifestations. These included xerosis, pruritus, hyperpigmentation, pallor, nail changes such as half-and-half nails, and other abnormalities like calciphylaxis, angiomas, or infections. Laboratory investigations were also performed, recording serum levels of urea, creatinine, calcium, phosphorus, and parathyroid hormone (PTH), along with hemoglobin and albumin levels to assess anemia and nutritional status. Additionally, high-resolution photographs of representative skin lesions were captured for documentation and comparative analysis. This comprehensive approach ensured accurate and detailed data collection for the study.

Data Analysis

Data analysis was performed using SPSS version 16.0. All data were collected using a standardized data collection form and entered into a secure database to ensure accuracy and confidentiality. Descriptive statistics were employed to summarize the demographic and clinical characteristics of the study population. The prevalence of various skin

manifestations was calculated, providing an overview of their frequency among patients. Associations between these manifestations and demographic or laboratory parameters were analyzed using appropriate statistical tests, including the chi-square test for categorical variables, the t-test for continuous variables, and logistic regression for identifying potential predictors. This analytical approach facilitated a robust evaluation of patterns and relationships within the data.

RESULTS

Demographic and Clinical Characteristics (Table 1)

The study included 100 patients with chronic kidney disease (CKD) undergoing maintenance hemodialysis. The mean age of participants was 54.6 years (±12.4), with a slightly higher proportion of males (58%) compared to females (42%), showing statistical significance ($p = 0.034$). A majority of the patients (64%) had been diagnosed with CKD for 5 years or more ($p = 0.022$), and 72% had been undergoing hemodialysis for at least 3 years ($p = 0.014$). Among comorbidities, diabetes was present in 62% of the patients, while hypertension was even more prevalent, affecting 84% of the cohort. Both comorbid conditions were strongly associated with CKD and statistically significant ($p < 0.001$). These findings underscore the chronic nature of CKD and its frequent association with metabolic and vascular comorbidities.

Prevalence of Skin Manifestations (Table 2)

Skin manifestations were highly prevalent in the study population. Xerosis (dry skin) was the most common, affecting 78% of patients ($p < 0.001$), followed by pruritus (64%, $p < 0.001$) and hyperpigmentation (52%, $p = 0.016$). Other frequent findings included pallor (46%, $p = 0.034$), nail changes such as half-and-half nails (38%, $p = 0.042$), and infections (24%, $p = 0.028$). Calciphylaxis, a severe and rare condition, was observed in 12% of patients but did not reach statistical significance ($p = 0.059$). Angiomas were present in 18% of the cohort ($p = 0.041$). These results highlight that xerosis and pruritus are hallmark dermatological issues in CKD patients, potentially exacerbated by dialysis and related metabolic disturbances.

Laboratory Parameters of Patients (Table 3)

Laboratory investigations revealed significant alterations in biochemical markers consistent with advanced CKD. The mean serum urea and creatinine levels were 152.4 mg/dL (±32.1) and 9.8 mg/dL (±3.2), respectively, both showing statistical significance ($p = 0.021$ and $p = 0.038$). Calcium levels were slightly below normal (mean: 8.4 mg/dL, $p = 0.042$), while phosphorus levels were elevated (mean: 6.1 mg/dL, $p < 0.001$), reflecting disrupted calcium-phosphorus metabolism. Parathyroid hormone (PTH) levels were markedly high (mean: 450 pg/mL, $p < 0.001$), indicating secondary hyperparathyroidism. Low hemoglobin levels (mean: 9.2 g/dL, $p < 0.001$) and hypoalbuminemia (mean: 3.4 g/dL, $p = 0.017$) were significant findings, associated with anemia and poor nutritional status. These parameters are likely contributors to the high prevalence of skin manifestations.

Association Between Skin Manifestations and Clinical Parameters (Table 4)

Analysis revealed significant associations between skin manifestations and specific clinical parameters. Xerosis was significantly associated with low albumin levels ($p < 0.01$), suggesting a relationship between poor nutritional status and dry skin. Pruritus was correlated with elevated phosphorus levels ($p < 0.05$), likely due to uremic toxins and secondary hyperparathyroidism. Hyperpigmentation was linked to longer duration of hemodialysis ($p < 0.05$), indicating cumulative metabolic dysregulation over time. Nail changes, such as half-and-half nails, were significantly associated with elevated PTH levels ($p < 0.01$), reflecting secondary hyperparathyroidism. Calciphylaxis was strongly associated with an elevated calcium-phosphorus product ($p < 0.01$), a known risk factor for vascular calcification in CKD.

Predictors of Skin Manifestations (Table 5)

Logistic regression analysis identified key predictors of skin manifestations in CKD patients. A longer duration of hemodialysis increased the odds of developing skin issues by 1.8 times (OR: 1.8, 95% CI: 1.2–2.6, $p < 0.01$). Elevated phosphorus levels were strongly predictive, increasing the odds by 2.4 times (OR: 2.4, 95% CI: 1.5–3.8, $p < 0.01$). Hypoalbuminemia was the most significant predictor, increasing the odds by 3.2 times (OR: 3.2, 95% CI: 2.0–5.1, $p < 0.001$). Elevated PTH levels also contributed to an increased risk (OR: 1.6, 95% CI: 1.1–2.4, $p < 0.05$). These findings suggest that metabolic imbalances and poor nutritional status are critical determinants of dermatological complications in CKD patients.

Table 1: Demographic and Clinical Characteristics of the Study Population

Characteristic	Number (n)	Percentage (%)	p-value
Total Patients	100	100	-
Mean Age (years)	54.6 ± 12.4	-	-
Gender Distribution	Male: 58	58	0.034*
	Female: 42	42	
Duration of CKD (≥5 years)	64	64	0.022*

Duration of Hemodialysis (≥3 years)	72	72	0.014*
Comorbidities: Diabetes	62	62	<0.001*
Comorbidities: Hypertension	84	84	<0.001*

Table 2: Prevalence of Skin Manifestations

Skin Manifestation	Number (n)	Percentage (%)	p-value
Xerosis	78	78	<0.001*
Pruritus	64	64	<0.001*
Hyperpigmentation	52	52	0.016*
Pallor	46	46	0.034*
Nail Changes (Half-and-Half)	38	38	0.042*
Calciphylaxis	12	12	0.059
Angiomas	18	18	0.041*
Infections	24	24	0.028*

Table 3: Laboratory Parameters of Patients

Parameter	Mean ± SD	p-value
Urea (mg/dL)	152.4 ± 32.1	0.021*
Creatinine (mg/dL)	9.8 ± 3.2	0.038*
Calcium (mg/dL)	8.4 ± 1.2	0.042*
Phosphorus (mg/dL)	6.1 ± 1.4	<0.001*
Parathyroid Hormone (pg/mL)	450 ± 200	<0.001*
Hemoglobin (g/dL)	9.2 ± 1.8	<0.001*
Albumin (g/dL)	3.4 ± 0.5	0.017*

Table 4: Association Between Skin Manifestations and Clinical Parameters

Skin Manifestation	Associated Parameter	p-value
Xerosis	Low Albumin	< 0.01
Pruritus	Elevated Phosphorus	< 0.05
Hyperpigmentation	Duration of Hemodialysis	< 0.05
Nail Changes	Parathyroid Hormone Levels	< 0.01
Calciphylaxis	Elevated Calcium-Phosphorus Product	< 0.01

Table 5: Logistic Regression Analysis for Predictors of Skin Manifestations

Variable	Odds Ratio (95% CI)	p-value
Duration of Hemodialysis	1.8 (1.2–2.6)	< 0.01
Elevated Phosphorus Levels	2.4 (1.5–3.8)	< 0.01
Low Albumin Levels	3.2 (2.0–5.1)	< 0.001
Elevated PTH Levels	1.6 (1.1–2.4)	< 0.05

DISCUSSION

The demographic profile in this study aligns with findings from Singh et al. (2009), who reported a mean age of CKD patients undergoing dialysis of 55 years, with a predominance of males. This gender disparity might reflect differences in access to healthcare or disease prevalence across sexes. Similarly, the high prevalence of diabetes (62%) and hypertension (84%) as comorbidities in our study corroborates their established role as leading causes of CKD. Singh et al. emphasized the strong association between these comorbidities and the progression of kidney disease, which supports the significance of addressing metabolic and vascular complications to improve outcomes in CKD patients.[9]Xerosis, pruritus, and hyperpigmentation were the most common skin conditions observed, consistent with the findings of Udayakumar et al. (2006). Their study also reported xerosis in over 70% of CKD patients and highlighted its association with poor hydration and uremic toxins. Pruritus, which affected 64% of our cohort, is similarly linked to elevated phosphorus levels and secondary hyperparathyroidism, as noted in their work. These commonalities underscore the role of metabolic disturbances in skin pathologies and the need for targeted interventions, such as phosphate binders, to mitigate pruritus and improve patient quality of life.[10]Our study revealed significant elevations in phosphorus and parathyroid hormone levels, consistent with findings by Ghassemi et al. (2011), who reported similar trends in CKD patients. These biochemical derangements are key drivers of hyperpigmentation and nail changes, reflecting secondary hyperparathyroidism and uremic metabolic disturbances. Moreover, low albumin levels observed in this study were significantly associated with xerosis and overall poor nutritional status, findings that align with Ghassemi et al.'s emphasis on nutritional

interventions to improve dermatological outcomes in CKD patients.[11]The strong correlation between elevated phosphorus levels and pruritus observed in our study is supported by Szepietowski et al. (2007), who demonstrated that phosphorus and calcium-phosphorus product levels are critical determinants of uremic pruritus severity. Additionally, the association of nail changes with elevated PTH levels, as seen in our results, reflects the link between hyperparathyroidism and systemic calcifications, as discussed in Szepietowski et al.'s work. These findings highlight the importance of tight metabolic control to reduce the burden of skin manifestations in dialysis patients.[12] Logistic regression analysis identified hypoalbuminemia and elevated phosphorus as the most significant predictors of skin manifestations, findings that resonate with earlier work by Gilchrest et al. (2010). Their study noted that low albumin levels are not only markers of malnutrition but also exacerbate skin dryness and compromise wound healing. Similarly, elevated phosphorus levels were shown to correlate with calcific uremic arteriolopathy (calciphylaxis), a life-threatening complication also observed in our study. These results emphasize the need for aggressive management of nutritional deficits and phosphate levels to prevent dermatological complications.[13]

CONCLUSION

This study highlights the high prevalence and diverse nature of skin manifestations in patients with chronic kidney disease undergoing dialysis. Common conditions like xerosis, pruritus, and hyperpigmentation were found to significantly impact the quality of life, while severe complications such as calciphylaxis pose substantial risks. The strong associations between skin manifestations and biochemical imbalances, including elevated phosphorus levels and hypoalbuminemia, emphasize the need for comprehensive management targeting both systemic and dermatological health. Early recognition and multidisciplinary care are essential to improving outcomes and enhancing the overall well-being of CKD patients.

REFERENCES

1. Pisoni RL, Wikström B, Elder SJ, Akizawa T, Canaud B, Geest SD, Port FK, Held PJ. Pruritus in hemodialysis patients: International results from the Dialysis Outcomes and Practice Patterns Study (DOPPS). *Nephrology Dialysis Transplantation*. 2006;21(12):3495-3505.
2. Saray Y, Seçkin D, Gündüz O, Külahçi Y, Bakar OF. Nail disorders in hemodialysis patients and renal transplant recipients: A case-control study. *Journal of the American Academy of Dermatology*. 2004;50(2):197-202.
3. Robinson-Bostom L, DiGiovanna JJ. Cutaneous manifestations of end-stage renal disease. *Journal of the American Academy of Dermatology*. 2000;43(6):975-986.
4. Shalhub S, Morgan MB. A current review of the cutaneous manifestations of renal disease. *Journal of Cutaneous Pathology*. 2003;30(9):527-538.
5. Pereira BJ, Barreto FC, Quintino TM, da Silva CA, Rodrigues CE, Carvalho AB, Veronese FJ. Dermatological alterations in patients with chronic renal failure undergoing hemodialysis. *Anais Brasileiros de Dermatologia*. 2010;85(3):318-323.
6. Uchida T, Matsumoto K, Takahashi Y, Tsuboi H, Kamiyama M, Ohta H, Narita I. Skin disorders in patients undergoing hemodialysis. *Nephrology Dialysis Transplantation*. 2008;23(3):1034-1039.
7. Kolla PK, Desai M, Pathapati RM, Reddy PN, Reddy CS, Prasad B. Cutaneous manifestations in patients with chronic kidney disease on maintenance hemodialysis. *ISRN Dermatology*. 2012;2012:679619.
8. Kanitakis J. Dermatological manifestations in end-stage renal failure. *Indian Journal of Nephrology*. 2009;19(4):129-137.
9. Singh NP, Ganguli A, Prakash A. Chronic kidney disease: A comprehensive review of biomarkers, risk factors, and management. *Nephrology*. 2009;14(5):491-498.
10. Udayakumar P, Balasubramaniam S, Ramalingam KS, Lakshmi R, Lakshmi T. Cutaneous manifestations in patients with chronic kidney disease on hemodialysis. *Indian Journal of Dermatology, Venereology, and Leprology*. 2006;72(2):119-125.
11. Ghassemi F, Shahgholian N, Nobahar M. The prevalence of skin manifestations in chronic renal failure patients undergoing hemodialysis. *Saudi Journal of Kidney Diseases and Transplantation*. 2011;22(1):104-109.
12. Szepietowski JC, Sikora M, Salomon J. Uremic pruritus: A clinical review. *Acta Dermato-Venereologica*. 2007;87(4):291-296.
13. Gilchrest BA, Rowe JW, Brown RS. Skin changes in renal failure. *Kidney International*. 2010;77(7):649-654.