



Cutaneous Manifestations in Chronic Renal Failure Patients on Hemodialysis: A Cross-Sectional Study

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Abstract

Introduction: Cutaneous manifestations in chronic renal failure (CRF) patients undergoing hemodialysis are indicative of underlying pathology but are understudied, particularly in low- and middle-income countries. This study aims to assess the prevalence and patterns of cutaneous manifestations in CRF patients undergoing hemodialysis.

Methods: An observational cross-sectional study was conducted over 18 months in a tertiary care hospital's Dialysis Unit. A total of 105 CRF patients undergoing hemodialysis were included. Data on demographics, comorbidities, blood parameters, and cutaneous manifestations were collected and analyzed using appropriate statistical methods.

Results: The mean age of participants was 47.53 years, with 39% aged 41-50 years. Diabetes (85.71%) and hypertension (83.8%) were the most prevalent comorbidities. Pruritus (66.67%) and xerosis (49.52%) were the most common cutaneous manifestations. Pallor (38.09%) and acquired perforating dermatosis (15.24%) were also notable. Nail changes (30.48%) and mucosal changes (20.95%) were observed, along with various infections.

Conclusions: Diabetes and hypertension were the predominant etiologies of CRF, with pruritus and xerosis showing positive correlation with CKD duration. Pallor and acquired perforating dermatosis were prevalent, especially in diabetic patients.

Keywords: Chronic Renal Failure; Hemodialysis; Cutaneous Manifestations; Comorbidities, Pruritus

Abbreviations

CRF: Chronic Renal Failure; CKD: Chronic Kidney Disease; ESRD: End-Stage Renal Disease; RBS: Random Blood Sugar.

Introduction

The skin serves as a visible indicator of underlying renal pathology, with up to 100% of end-stage renal disease

(ESRD) patients experiencing cutaneous changes [1]. Common manifestations include xerosis, pruritus, pigmentation changes, and infections [2,3]. Despite the increasing prevalence of ESRD, particularly in low and middle income countries like India, there remains a paucity of comprehensive studies on dermatological manifestations in this population [4,5]. Understanding the prevalence and patterns of dermatological issues in chronic renal failure patients on hemodialysis is essential for effective management [6]. These manifestations not only impact the quality of life but may also serve as indicators of disease progression and treatment efficacy [7,8]. The objective of this study is to evaluate the prevalence and patterns of cutaneous manifestations in chronic renal failure patients undergoing hemodialysis.

Materials and Methods

An observational cross-sectional study was conducted in the Dialysis Unit of a tertiary care hospital, providing specialized care for patients with chronic renal failure, over duration of 18 months. Inclusion criteria encompassed all patients diagnosed with chronic renal failure undergoing hemodialysis, while exclusion criteria excluded patients unwilling to participate, those post renal transplants and on dialysis, immunocompromised individuals, and patients with chronic liver disease. No specific facilities or equipment were required for the study. The minimum required sample size was calculated with,

$$n = Z^2 \frac{pq}{d^2}$$

$$= 1.96^2 \frac{0.82 \times 0.18}{0.08^2} = 89$$

Where,

N: Minimum required sample size

Z: Z-score of approximately 1.96 for a 2-sided test with 95% confidence level

P: 0.82 (prevalence of cutaneous manifestations based on similar study [9])

Q: 1 - P = 0.18

D: Maximum error in the estimate i.e. 0.08 ($\pm 8\%$ maximum error in the estimate)

The minimum required sample size was 89 and a total of 105 patients were taken after screening them according to the defined criteria, obtaining informed consent, and collecting demographic data. Thorough examinations were conducted to identify any cutaneous manifestations, accompanied by detailed history-taking, clinical examinations, and

relevant laboratory and histopathological investigations. Data was recorded using a specially designed case record form. Data on age, gender, duration of illness, duration of dialysis, associated comorbidities (such as diabetes and hypertension), blood parameters (including urea, creatinine, hemoglobin, and random blood sugar levels), cutaneous manifestations, cutaneous infections, nail changes, hair changes, and mucosal changes were collected and analyzed in the study. Additionally, comparisons were made based on the duration of CKD and dialysis, as well as the association between skin manifestations and serum urea levels.

Statistical analysis involved categorizing observed cutaneous manifestations into subgroups and utilizing statistical tables. The frequencies (n) and percentages (%) were expressed in n (%) format and the mean values were expressed along with their standard deviations (Mean \pm Standard deviation) with independent student's t-tests performed for comparisons between groups. Categorical variables, including the proportion of subjects with cutaneous conditions and complications, were expressed as percentages and analyzed using the Chi-square test (χ^2). Significance was set at a p-value below 0.05. Efforts were made to address potential sources of bias throughout the study which included clear selection criteria, standardized data collection, blinding techniques, adjusting for confounders, and transparent reporting.

Results

The study assessed 105 patients with chronic renal failure undergoing dialysis. The mean age of the 105 study participants was 47.53 \pm 10.91 years. A total of 41 (39%) patients belong to the age group between 41-50 years (Table 1).

Age Group (years)	n (%)
<30	6 (5.7)
31-40	19 (18.1)
41-50	41 (39)
51-60	28 (26.7)
61-70	9 (8.6)
>70	2 (1.9)

Table 1: Distribution of patients according to age group (n=105).

Out of 105 patients, 65 (61.9%) were males and 40 (38.1%) were females. Table 2 illustrates the distribution of patients based on the duration of illness and duration of dialysis: 71 patients (67.6%) had an illness duration ranging from 1 month to 1 year. The duration of dialysis ranged from 2 days to 5 years (Table 2).

Duration	Duration of Illness n (%)	Duration of Dialysis n (%)
<1 month	2 (1.9)	21 (20)
1 month - 1 year	71 (67.6)	80 (76.2)
> 1 year	32 (30.5)	4 (3.8)

Table 2: Distribution of patients according to duration of illness (n= 105).

A total of 80 (76.2%) patients had undergone hemodialysis dialysis, 21 (20%) had undergone only peritoneal dialysis while 4 (3.8%) had undergone both Peritoneal

and Hemodialysis. Table 3 demonstrates the associated comorbidities of chronic kidney disease: 90 (85.71%) had diabetes, while 88 (83.8%) had hypertension (Table 3).

Comorbidities	n (%)
Diabetes	90 (85.71)
Hypertension	88 (83.8)
CAD	2 (1.90)
Hypothyroidism	1 (0.95)
RHD/MS	1 (0.95)
Severe MR/Moderate TR/Severe PHT	1 (0.95)
Sputum Positive Pulmonary TB	1 (0.95)
TB Lymphadenitis	1 (0.95)

CAD: Coronary Artery Disease; TB: Tuberculosis; RHD: Rheumatic Heart Disease; MS: Mitral Stenosis; MR: Mitral Regurgitation; TR: Tricuspid Regurgitation; PHT: Pulmonary Hypertension.

Table 3: Chronic Kidney Disease association with other comorbidities (n= 105).

The blood parameters (Mean±standard deviation, minimum-maximum) of the study participants are presented as follows: urea (170.12±72.54 mg/dL, 58.0-376.0 mg/dL), creatinine (11.888±5.5372 mg/dL, 2.4-23.5 mg/dL), hemoglobin (8.078±11.7621 g/dL, 3.4-126.0 g/dL), and random blood

sugar (RBS) levels (124.229±55.9012 mg/dL, 50.0-333.0 mg/dL). The prevalence of the cutaneous manifestations, cutaneous infections, nail changes, hair changes and mucosal changes are tabulated in Table 4 & 5.

Parameters	Males n (%)	Females n (%)	Total n (%)
Cutaneous Manifestations			
Pruritis	41 (39.05)	29 (27.62)	70 (66.67)
Xerosis	33 (31.43)	19 (18.10)	52 (49.52)
Pallor	29 (27.62)	11 (10.48)	40 (38.09)
Acquired Perforating Disorders	12 (11.43)	4 (3.81)	16 (15.24)
Pigmentary Changes	1 (0.95)	5 (4.76)	6 (5.71)
Purpura	1 (0.95)	1 (0.95)	2 (1.90)
Shunt Dermatitis	1 (0.95)	1 (0.95)	2 (1.90)
Cutaneous Infections			
Tinea corporis	6 (5.71)	4 (3.81)	10 (9.52)
Herpes labialis	-	1 (0.95)	1 (0.95)
Herpes zoster	1 (0.95)	-	1 (0.95)
Pyoderma	-	1 (0.95)	1 (0.95)

Total	7 (6.67)	6 (5.71)	13 (12.38)
Nail Changes			
Half & half nail	11 (10.48)	-	11 (10.48)
Onychomycosis	2 (1.90)	1 (0.95)	3 (2.86)
Onycholysis	1 (0.95)	3 (2.86)	4 (3.81)
Subungual hyperkeratosis	1 (0.95)	1 (0.95)	2 (1.90)
Mee's line	-	2 (1.90)	2 (1.90)
Beau's line	2 (1.90)	-	2 (1.90)
leukonychia	5 (4.76)	-	5 (4.76)
Longitudinal melanonychia	2 (1.90)	1 (0.95)	3 (2.86)
Total	24 (22.86)	8 (7.62)	32 (30.48)
Hair Changes			
Scalp hair loss	1 (0.95)	4 (3.81)	5 (4.76)
Dry and lustreless hair	-	1 (0.95)	1 (0.95)
Total	1 (0.95)	5 (4.76)	6 (5.71)
Mucosal Changes			
Macroglossia with teeth marking	10 (9.52)	5 (4.76)	15 (14.29)
Uremic fetor	2 (1.90)	-	2 (1.90)
Xerostomia	3 (2.86)	2 (1.90)	5 (4.76)
Total	15 (14.28)	7 (6.67)	22 (20.95)

Table 4: Prevalence of the cutaneous manifestations, cutaneous infections, nail changes, hair changes and mucosal changes (n=105).

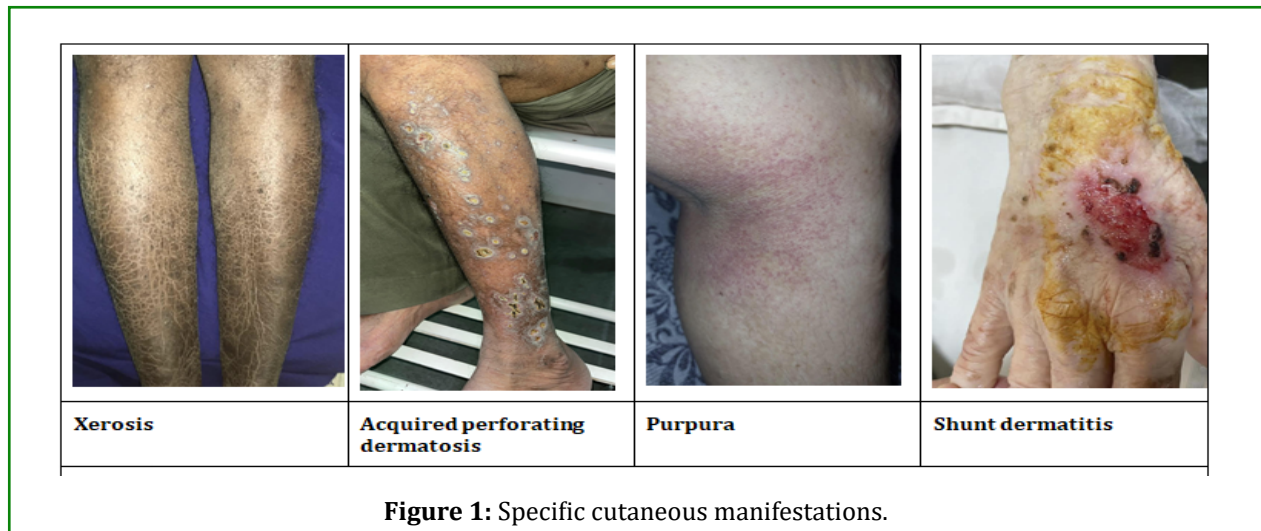
	Duration of CKD (months)			Duration of Dialysis (months)		
	<6	06-Dec	≥12	<6	06-Dec	≥12
Pruritus	22	13	35	46	12	12
Xerosis	15	11	26	35	8	9
Pallor	10	7	23	28	6	6
Pigmentation	0	0	5	3	0	2
Acquired perforating disorder	7	0	9	11	2	3

CKD: Chronic Kidney Disease.

Table 5: Compares the cutaneous manifestations with respect to duration of CKD and duration of dialysis.

Among the 105 patients, those experiencing pruritus were distributed as follows: 12 (11.4%) had urea levels below 100, 27 (25.7%) had levels exceeding 200, and 31 (29.5%) fell within the range of 101-200. For xerosis, 6 (5.7%) patients had urea levels below 100, 22 (20.9%) had levels exceeding 200, and 24 (22.9%) fell within the range of 101-200. Pallor was observed in 5 (4.8%) patients with urea levels below

100, 15 (14.3%) with levels exceeding 200, and 20 (19%) with levels between 101-200. Pigmentation was present in 1 (1%) patient with urea levels below 100 and 4 (3.8%) with levels between 101-200. Acquired perforating disorders were observed in 4 (3.8%) patients with urea levels below 100, 9 (8.6%) with levels exceeding 200, and 3 (2.9%) with levels between 101-200 (Figure 1 & 2).



Discussion

Our study aimed to evaluate the prevalence and patterns of cutaneous manifestations in chronic renal failure patients undergoing hemodialysis. The key findings revealed pruritus (66.67%) and xerosis (49.52%) were common cutaneous manifestations, showing correlations with CKD duration but inversely with dialysis duration.

The mean age of our participants was 47.53 years, with 39% falling within the 41-50 years age group. Gupta S [10] and Deshmukh SP, et al. [11] reported similar mean ages. Our study revealed a sex ratio of 1.6:1 (male: female), akin to

Gupta et al.'s findings [10]. Diabetes mellitus was the most prevalent comorbidity, affecting 90 patients (85.71%), followed by hypertension in 88 patients (83.8%), similar to Gupta S study [10]. Pruritus affected 70 patients (66.67%), correlating positively with CKD duration but negatively with dialysis duration. Xerosis was observed in 52 patients (49.52%), correlating with urea levels and CKD duration but inversely with dialysis duration, consistent with Gupta S [10], Deshmukh SP, et al. [11] and Thomas EA, et al. [12].

Pallor was noted in 40 patients (38.09%), predominantly due to anemia, which was comparable to Udayakumar P, et al. [9]. The mean hemoglobin in these 40 patients (8.078

gm%, S.D.=11.76). Udayakumar P, et al. [9] and Deshmukh SP, et al. [11] found the prevalence of pallor as 60% and 68.57% in their respective studies. Sixteen patients (15.24%) exhibited acquired perforating dermatosis, with all cases being diabetic, suggesting a potential association between diabetes and this condition. Similarly, Udayakumar P, et al. [9] and Sanad E, et al. [13] reported the prevalence of APD in their studies as 21% and 10%, respectively.

Pigmentary alterations, including hyperpigmentation and facial yellowing, were observed in a minority of patients, with potential mechanisms involving melanocyte-stimulating hormone and retained lipid-soluble pigments [12]. Similar pigmentary changes were observed in studies done by Gupta S [10] (21.92%, 8.22%) and Thomas EA, et al. [12] (32.3%, 5.05%). Purpura was seen in 2 patients (1.9%) in our study. This is similar to the study done by Thomas EA, et al. [12] (10.1%), which is also consistent with the report of Remuzzi G [14]. Arteriovenous shunt dermatitis was seen in 2 patients (1.9%). Udayakumar P, et al. [9] and Gupta S [10] reported shunt dermatitis in 2% and 2.7% of their study patients, respectively.

Cutaneous infections were seen in 13 patients (12.38%) in our study, 10 (9.52%) of whom had tinea corporis. 1 patient each had herpes labialis (0.95%) and herpes zoster (0.95%) and 1 patient had pyoderma (0.95%). Udayakumar P, et al [9] and Thomas EA, et al. [12] reported the prevalence of cutaneous infections in their studies as 32.8% and 26.26% respectively. Nail changes were seen in 32 (30.48%) of our patients. 11 patients (10.48%) had half & half nails, 4 patients (3.81%) had onycholysis, 3 patients (2.86%) showed longitudinal melanonychia, 3 patients (2.86%) had onychomycosis, 2 each (1.90%) showed subungual hyperkeratosis and Beau's line and Mee's line and 5 patients (4.76%) had leukonychia. These findings are consistent with the studies done by Gupta S [10] (47.9 %) and Thomas EA, et al. [12] (36.36%).

Hair changes were noted in 6 patients (5.71%), of which 5 patients (4.76%) showed sparse hair on the scalp. One patient (0.95%) had dry lusterless hair, which is postulated to occur due to decreased secretion of sebum in CRF patients [11]. Similarly, Sanad E, et al. [13] found sparse scalp hair in 46% and dry lusterless hair in 47% of their patients while, Udayakumar P, et al [9] found sparse scalp hair in 11% and dry hair in 16% of their cases. Similarly, in our study 22 patients (20.95%) showed mucosal changes. Macroglossia with teeth marking (tongue sign of uremia) was first described by Mathew in 92% of patients with CKD Mathew MT, et al. [15] which was seen in 15 (14.29%) of our patients. Xerostomia was seen in 5 (4.76%) of the patients, which could be attributed to mouth breathing and dehydration. Uremic fetor was noticed in 2 patients (1.9%). These findings

are similar to those observed by Thomas EA, et al. [12] where 9.09 % patients had macroglossia with teeth marking and 5.05% patients had xerostomia.

The study's limitations include its single-center design, small sample size, and cross-sectional nature, which hinder generalizability and causal inference. Measurement bias in clinical assessments, potential confounding, and selective reporting bias may affect the accuracy and validity of results. Future research should address these limitations by employing larger, more diverse samples, longitudinal designs, standardized assessments, and transparent reporting practices.

Conclusion

On the basis of our study, we concluded that diabetes and hypertension were the most common etiologies of CKD. Xerosis and perforating dermatosis were more prevalent in patients with rising serum urea levels, which is an indicator that intervention on the appearance of these cutaneous manifestations would be beneficial to the patients. Pruritus and xerosis showed positive correlation with the duration of CKD. Prompt recognition and treatment of infection in patients with CKD, especially on maintenance dialysis is useful for improving the quality of life.

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Conflict of Interest

The authors declare no conflict of interest.

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