



NAIL DISORDERS IN HEMODIALYSIS PATIENTS WITH CHRONIC KIDNEY DISEASE: A CROSS-SECTIONAL STUDY

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ABSTRACT

Background: Nail disorders are common among chronic kidney disease (CKD) patients who are on maintenance hemodialysis. Even though nail abnormalities have been reported in individuals with renal impairment as well as individuals who have undergone peritoneal dialysis, there is a paucity of data that specifically discusses its prevalence in maintenance hemodialysis patients.

Objectives: To identify the incidence and nature of nail disorders among patients with CKD who are on maintenance hemodialysis.

Materials and Methods: It was a cross-sectional study that was carried out at the Department of Nephrology, Sir Ganga Ram Hospital, Lahore, between February 1, 2020, and August 1, 2022. The number of patients who were enrolled was 292. The clinical and laboratory diagnosis of CKD of all the patients was within two months of maintenance hemodialysis. A digital 6.0-megapixel camera was used to take nail photographs which were rated by three dermatologists independently. The diagnosis was confirmed by at least two specialists to confirm that there was a disorder. The SPSS v25.0 was used to analyze data. As a stratification factor, age, sex, and dialysis time were carried out and chi-square test was utilized; p 583

Results: Out of the 292 patients, 198 (67.8) of them were male and 94 (32.2) were female with the mean age of 47.312.4 years. There were 197 patients who had nail disorders (67.5%). Half-and-half nails was the most prevalent abnormality (40.8%), then splinter hemorrhages (19.2%), onycholysis (17.8%), absent lunula (16.1%), melanonychia (6.5%), chromonychia (5.5%) and Beau lines (5.1%). Abnormalities of nails had a significant relationship with both age and dialysis duration but not gender.

Conclusion: Nail disorders are prevalent among patients with CKD under maintenance hemodialysis. In clinical assessment, the procedure of nail examination on a regular basis should be used as a cursory, non-invasive intervention to detect systemic complications and track the burden of disease.

Keywords: Chronic Kidney Disease, Hemodialysis, Nail Disorders, Half-and-Half Nails, Absent Lunula

INTRODUCTION

Chronic kidney disease (CKD) is a persistent disorder that can be described as gradual and irreversible deterioration of renal functioning throughout months or years¹. It is a significant health concern in the world, which is accompanied by high morbidity, mortality and health-care expenditures. The two factors that are of the greatest importance in terms of their etiological contribution to the increasing incidence of CKD across the globe are diabetes mellitus and hypertension². The rate at which the disease progresses is that the glomerular filtration rate (GFR), which is normal between 110 and 120 ml/min, deteriorates with progression of the disease, as the rate drops to approximately less than 15 ml/min at end-stage renal disease (ESRD). The survival of patient requires renal replacement therapy as maintenance hemodialysis or kidney transplantation at this stage^{3,4}.

The systemic complications affecting various organs in CKD patients are enormous and broad especially in patients under long-term hemodialysis⁵. One of the most common and clinically significant manifestations is dermatological, which occurs as a result of the stagnation of the products of metabolic wastes, as a result of anemia, as a result of nutritional deficiency, as a result of immune defects and factors of treatment. The skin alterations are described well like pruritus, xerosis, hyperpigmentation and calcinosis. Nevertheless, nail abnormalities are less valued in clinical practice because they are not prioritized despite their easy observance during the physical examination⁶.

Nail diseases among CKD patients are multifaceted and can be used as an external symptom of an internal malfunction in the system⁷. Half-and-half nails (Lindsay) absent lunula, splinter haemorrhages, onycholysis, melanonychia, chromonychia, Beau, lines, leukonychia, koilonychia and Muehrcke lines are the most frequently reported abnormalities⁸. It is assumed that the above manifestations are caused by complicated interplay of various pathophysiological factors, such as anemia, hypoalbuminemia, metabolic bone disease, vascular changes, and calcium-phosphate metabolic disturbances. Moreover, the nail changes have been closely associated with the period of dialysis and the frequency and intensity of such changes, implying that the changes can also serve as indirect markers of dialysis performance and burden of chronic diseases⁹.

These nail alterations are not only clinically relevant due to cosmetic issues. They can be useful sources of both the diagnostic and prognostic data, warn clinicians about potential systemic complications, and even mirror the underlying biochemical imbalances. The occurrence and the range of nail abnormalities in CKD patients under hemodialysis is little reported in most populations, including ours. The differences in prevalence as reported in the different parts of the world could be due to ethnic differences, diets, socioeconomic conditions and differences in dialysis regimens^{10,11}.

Based on the importance of these conclusions, it is important to record and examine nail disorders among CKD patients. Setting up their prevalence in the local population can not only assist clinicians in early detecting of complications but can also be used in coming up with guidelines on routine physical examination and follow up on dialysis patients¹².

The present study was therefore undertaken to determine the prevalence and types of nail disorders among patients with chronic kidney disease undergoing maintenance hemodialysis, with the aim of highlighting their clinical importance and contributing to improved patient care¹³.

MATERIALS AND METHODS

The study was conducted at Sir Ganga Ram Hospital, Lahore from February 1, 2020 to August 1, 2022. It was a Cross-Sectional Study. After approval from hospital ethical committee, 292 cases fulfilling the inclusion criteria, were enrolled in this study from dialysis unit of SGRH. Informed consent was taken from each subject. The inclusion criteria was; all patients of either gender having

ages between 18-70 years on maintenance hemodialysis for atleast 2 months. The exclusion criteria was; patients receiving dialysis for AKI (Serum creatinine $\geq 50\%$ from baseline assessed after 48 hours of admission) and patients not giving consent.

The estimated sample size 292 was estimated by 95% confidence level with 2.5% margin of error and by taking expected percentage of Beau's Lines i.e. 5% in patients with CKD undergoing haemodialysis.³ chronic kidney disease was defined as kidney damage with glomerular filtration rate (GFR) of less than 60ml/min for three or more months. Patients who had Glomerular Filtration Rate (GFR) of $<15\text{ml/min/1.73m}^2$ and underwent twice weekly hemodialysis for atleast 3 months.

Bio-data clinical examination and review of record was done according to Proforma. Hemodialysis in the Department of Nephrology occurred in patients with a clinical and laboratory diagnosis of CKD. The researchers analyzed and filmed patients' nails in hemodialysis using a digital 6.0 megapixel camera. Three dermatologists later examined these photographs separately and were deemed positive for a disorder if at least two of the three specialists agreed on their diagnosis. In patients with absent lunula, onycholysis, half and half nail, beau's curves, chromonychias, splinter hemorrhages, and melanonychias, nail disorders were examined.

The data were entered and analyzed using SPSS v25.0. Quantitative variable like age was presented in Mean $\pm$ S.D form. All qualitative variables like gender, duration of dialysis and frequency and types of Nail Disorder were presented in the form of frequencies or percentages. Age, gender and length of dialysis data had been stratified. Chi-Square was used for post-stratification. A p-value up to 0.05 was deemed significant.

RESULTS

A total of 292 patients with chronic kidney disease (CKD) on maintenance hemodialysis for at least two months were enrolled in the study. Among these, 198 (67.8%) were male and 94 (32.2%) were female, yielding a male-to-female ratio of approximately 2:1. The mean age of the study population was 47.3 ± 12.4 years. Age distribution revealed that 101 patients (34.6%) were between 20–40 years, 141 (48.3%) were between 41–60 years, and 50 (17.1%) were above 60 years.

With respect to dialysis duration, 108 patients (37.0%) were on dialysis for less than one year, 84 (28.8%) had received dialysis for 1–3 years, 77 (26.4%) for 3–6 years, and 23 (7.9%) for more than six years.

Frequency of Nail Disorders

Overall, 197 patients (67.5%) were found to have nail abnormalities, while 95 (32.5%) had no detectable nail changes (Table 1). The most frequent nail abnormality was half-and-half nails, observed in 119 patients (40.8%). Other notable findings included splinter hemorrhages in 56 patients (19.2%), absent lunula in 47 patients (16.1%), onycholysis in 52 patients (17.8%), melanonychia in 19 patients (6.5%), chromonychia in 16 patients (5.5%), and Beau's lines in 15 patients (5.1%).

Table 1. Frequency distribution of nail disorders

Nail disorder	Frequency	Percentage
Yes	197	67.5%
No	95	32.5%
Total	292	100%

Association with Gender

Stratification by gender revealed no statistically significant association between nail disorders and gender ($p = 0.911$). Among males, 134 (67.7%) exhibited nail disorders compared to 63 (67.0%) of females (Table 2).

Table 2. Stratification of nail disorders with respect to gender

Gender	Nail disorder (Yes)	Nail disorder (No)	Total	p-value
Male	134 (67.7%)	64 (32.3%)	198	0.911
Female	63 (67.0%)	31 (33.0%)	94	
Total	197 (67.5%)	95 (32.5%)	292	

Association with Age Groups

When stratified by age, a significant association was found between increasing age and the presence of nail disorders ($p = 0.002$). Nail changes were seen in 67 patients (66.3%) aged 20–40 years, 86 patients (61.0%) aged 41–60 years, and 44 patients (88.0%) above 60 years (Table 3).

Table 3. Stratification of nail disorders with respect to age groups

Age group	Nail disorder (Yes)	Nail disorder (No)	Total	p-value
20–40 years	67 (66.3%)	34 (33.7%)	101	0.002
41–60 years	86 (61.0%)	55 (39.0%)	141	
>60 years	44 (88.0%)	6 (12.0%)	50	
Total	197 (67.5%)	95 (32.5%)	292	

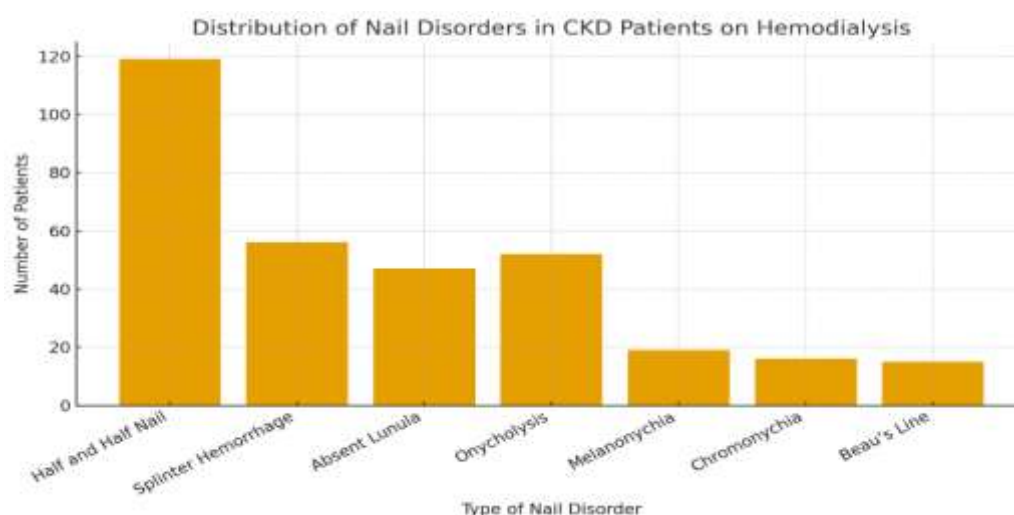
Association with Duration of Dialysis

Duration of dialysis showed a highly significant correlation with nail disorders ($p = 0.000001$). Only 16 patients (14.8%) undergoing dialysis for less than one year exhibited nail abnormalities, compared to 81 patients (96.4%) on dialysis for 1–3 years, 77 patients (100%) for 3–6 years, and 23 patients (100%) for more than six years (Table 4). This demonstrates a direct relationship between longer dialysis duration and increased frequency of nail disorders.

Table 4. Stratification of nail disorders with respect to duration of dialysis

Duration of dialysis	Nail disorder (Yes)	Nail disorder (No)	Total	p-value
<1 year	16 (14.8%)	92 (85.2%)	108	0.000001
1–3 years	81 (96.4%)	3 (3.6%)	84	
3–6 years	77 (100%)	0 (0.0%)	77	
>6 years	23 (100%)	0 (0.0%)	23	
Total	197 (67.5%)	95 (32.5%)	292	

A graphical representation of the distribution of nail disorders is shown in Figure 1, highlighting that half-and-half nails were the most frequent finding, followed by onycholysis and splinter hemorrhage.

**Figure 1. Distribution of nail disorders in CKD patients on maintenance hemodialysis.**

Overall, our findings highlight that nail disorders are highly prevalent in patients with chronic kidney disease on maintenance hemodialysis and increase significantly with advancing age and longer dialysis duration. These changes, although often regarded as minor or cosmetic, may serve as valuable non-invasive markers of systemic disease severity and treatment adequacy. Incorporating routine nail examination into the clinical assessment of CKD patients can therefore provide additional diagnostic insight, improve holistic patient care, and facilitate early recognition of associated complications.

DISCUSSION

There are numerous systemic and dermatological complications in chronic kidney disease (CKD) most of which can be readily seen and may yield valuable clinical clues¹³. There have been numerous reports of cutaneous manifestations, including xerosis, pruritus, perforating dermatoses, hyperpigmentation, and nail changes in such patients as either an extension or an effect of the underlying disease or the treatment. Our research revealed that at least one abnormality of the nails was observed in 67.5% of hemodialysis patients. This occurrence is also in line with the current literature, which indicates that nail disorders have a high prevalence of 52-82, which makes them clinically significant in CKD^{14,15}.

Our series prevalence is within the range of prevalence of the international studies, albeit with some variance. These discrepancies can be explained by the variation in dialysis methods, demographics of patients, comorbidity, and nutritional/hematologic status¹⁶. Significantly, we have shown that the appearance of nail changes, patient age, and dialysis period are significantly related. This strengthens the idea that accrued metabolic insults and dialysis exposure lead significantly to nail pathology in the case of CKD^{17,18}.

Half-and-half nails (Lindsay had half-and-half nails) were the most common abnormality in our cohort (40.8% of patients were observed to have this abnormality). The proximal pale area is ascribed to edema and anemia whereas the distal brown or reddish discolouration is most probably due to deposition of melanin and vascular alteration¹⁹. It has been found to be one of the most unique changes in nails that occur in the human body as studies carried out in Asia and Europe confirmed it. We had a higher rate however than certain other international cohorts possibly due to population idiosyncrasy like the intensity of anemia or the sufficiency of dialysis²⁰.

The other abnormalities reported were splinter hemorrhages (19.2%), onycholysis (17.8%), absent lunula (16.1%), melanonychia (6.5%), chromonychia (5.5%) and Beau lines (5.1%). These data correlate with other articles in which the absence of lunula, onycholysis, and splinter hemorrhage were also commonly found²¹⁻²⁴. Repeated trauma, secondary fungal infections or ischemic alterations in the nail bed may be the cause of onycholysis, whereas melanonychia and chromonychia have been attributed to metabolic imbalances, exposure to medications, or the deposition of melanin. The lines on Beau symbolize an acute arrest of nail growth which occurs in case of systemic stress, and have been identified in CKD patients, especially in the case of metabolic decompensation²⁵.

Our results also assured the fact that there was no significant difference in prevalence of nail changes with gender. This implies that the abnormalities of the nails in CKD are mostly caused by systemic and metabolic disruptions instead of a variation in the biological differences between the sexes^{26,27}. Remarkably, dermoscopic analysis has been gradually suggested in the evaluation of the minor nail changes, as it enables a better discrimination of uremic changes of nail and other pathological conditions including onychomycosis. This will specifically be applicable due to the fact that CKD patients have a predilection to fungal infections that can confound or present with renal-related nail pathology²⁸.

The etiological factors that cause these nail disorders are most probably multifactorial. Absent lunula and half-and-half nails have always been associated with anemia. Another prevalent complication of end stage CKD, hypoalbuminemia has also been implied as a causative factor, but findings are inconsistent across studies²⁹. Disturbed calcium-phosphate equilibrium, secondary hyperparathyroidism, and chronic inflammation are also possible factors resulting in the pathogenesis of nail matrix functionality. All of these findings together support the idea that nail abnormalities are

not a mere cosmetic phenomenon, as they indicate systemic disease burden, and the metabolic environment of renal failure³⁰.

We confirm the findings with the rest of the literature that places great importance on nail examination as an adjunct in the assessment of CKD patients because the measures are simple, which makes them non-invasive. The inclusion of nail evaluation in regular clinical practice can provide information on dialysis efficiency, nutritional condition, and the progression of the systemic diseases³¹.

This research study however has its limitations. As a single-centre cross-sectional study, our results might not be entirely applicable to the general population of CKD¹⁶. Besides, the nail photographs were assessed independently by the dermatologists, therefore, the dermoscopic and histopathological validation was not conducted, and that might have resulted in the under-identification of mild abnormalities. We also have not thoroughly studied the possibility of comorbidity like diabetes mellitus or vascular disease and have not made an adjustment to the nutritional and drug-related factors which may have a substantial effect on nail morphology^{7,21}.

Future studies need to therefore focus more on prospective, multi-centre longitudinal studies that involve large sample sizes and heterogeneous populations in order to confirm these results. Dermoscopy and molecular diagnostic methods should be included in order to enhance accuracy of diagnosis and be able to differentiate CKD-related alterations and other nail disorders^{17,19}. Mycological researches should also be factored in because onychomycosis is very likely to develop among dialysis patients. Also, it would be interesting to determine the correlation between nail changes and biochemical values, including serum albumin, hemoglobin, calcium-phosphate metabolism, and parathyroid hormone levels, to gain more mechanistic information²⁰.

Clinically, we suggest nephrologists, dermatologists and internists should include nail checks in physical assessment guidelines of CKD patients. Nail disorders can be the use of non-invasive, cost-effective clinical indicators of systemic disease burden, dialysis adequacy, and nutritional condition²⁵⁻²⁹. Timely diagnosis and proper treatment of such abnormalities have the potential to make patients more comfortable, self-image positive, and experience an enhanced quality of life, as well as be used as a complementary method of whole-person CKD care^{30,31}.

CONCLUSION

Chronic kidney disease on maintenance hemodialysis patients has an almost two-thirds prevalence of nail disorders. The most common abnormality was half-and-half nails which were more common with age and the length of dialysis. Regular nail care check should be regarded as a significant element of clinical examination among such patients.

Conflict of Interest:

The authors declare no conflict of interest.

Funding:

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Ethical Approval:

Ethical approval was obtained from the Institutional Review Board of Sir Ganga Ram Hospital, Lahore.

Informed Consent:

Written informed consent was obtained from all participants prior to inclusion in the study.

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Authors' Contribution

UR: Study conception, supervision, manuscript drafting.

NS: Study design, critical review.

FB: Data interpretation, statistical analysis.

LN: Data acquisition, patient recruitment.

FA: Clinical evaluation, data entry.

ON: Literature review, referencing, proofreading.

All authors approved the final manuscript.

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