

Prevalence and Clinical Spectrum of Dermatologic Conditions in Renal Transplant Recipients: A 10-Year Retrospective Cross-Sectional Study

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Background: The lifelong immunosuppressive therapy required to ensure graft survival in renal transplant recipients (RTRs) substantially increases their susceptibility to cutaneous infections, skin malignancies, and drug-induced dermatologic conditions. However, data on their prevalence and clinical spectrum remain limited.

Objective: To determine the prevalence and clinical spectrum of dermatologic conditions among RTRs.

Methods: A retrospective cross-sectional study design was performed using data extracted from the hospital health information system (BESTCare) to review the medical records of patients with renal transplantation who were referred for dermatologic evaluation over a ten-year period (2015–2025) at King Abdulaziz Medical City, Riyadh, Saudi Arabia (KAMC). Data analysis was conducted using SPSS (version 27.0). A multinomial logistic regression model was used to examine variables associated with dermatologic conditions.

Results: A total of 338 RTRs were included; among them, 174 (51.5%) were female. Infectious conditions were the most prevalent (37.3%), followed by inflammatory (24%), drug-induced (12.4%), hair disorders (11.5%), and neoplastic (5.9%). Viral warts were the most common infectious condition (52 cases, 41.3%), followed by superficial fungal infections (23 cases, 18.3%). Among neoplastic conditions, seborrheic keratosis was the most common benign neoplasm (7 cases, 35.0%), while squamous cell carcinoma (6 cases, 30.0%) and basal cell carcinoma (4 cases, 20.0%) were the most common malignant neoplasms. In multinomial logistic regression, increasing age was independently associated with higher odds of neoplastic conditions (OR = 1.10 per year; 95% CI, 1.05–1.15; $p < 0.001$). Sex was significantly associated with dermatologic conditions, with males having higher odds of inflammatory conditions (OR = 1.30; $p = 0.021$), while females had higher odds of hair disorders (OR = 4.16; 95% CI, 1.82–9.53; $p = 0.001$).

Conclusion: Our study characterized the range of dermatologic conditions encountered in RTRs and highlighted the need to incorporate dermatologic screening and follow-up into multidisciplinary transplant care.

Keywords: immunosuppression, renal transplantation, dermatologic conditions, prevalence, retrospective

Introduction

Renal transplantation continues to represent the gold standard therapy for end-stage renal disease (ESRD), with well-established advantages in improving patient survival and quality of life.¹ Over recent years, the global volume of renal transplant procedures has continued to rise, largely driven by the growing prevalence of chronic kidney disease worldwide.¹ Furthermore, advancements in surgical techniques, particularly the adoption of laparoscopic approaches, have resulted in favorable outcomes for both graft function and donor safety.² On a global scale, a total of 111,135 renal

transplant procedures were performed in 2023 for patients with ESRD.^{3,4} In 2024, the Saudi Center for Organ Transplantation reported that Saudi Arabia performed 203 deceased-donor renal transplants and 1,284 living-donor renal transplants.⁵

Immunosuppressive therapy is both essential and lifelong for RTRs, as it plays a role in preventing allograft rejection.⁶ However, the prolonged use of these agents is associated with a broad spectrum of dermatologic conditions involving the skin, mucous membranes, hair, and nails. These conditions may include opportunistic infections, drug-induced reactions, inflammatory dermatoses, and an elevated risk of cutaneous neoplasms.⁶ Certain pathogens primarily affect immunocompromised hosts and are classified as opportunistic infections; these involve the reactivation of latent viruses, such as varicella zoster virus (VZV), cytomegalovirus (CMV), and human herpes virus (HHV).⁷ In addition, inflammatory skin lesions, such as acneiform eruptions and dermatitis, are common drug-related reactions, whereas conditions such as psoriasis tend to occur less frequently due to the immunosuppressive state.⁸ Cutaneous infections were found to be the most common skin complication after renal transplantation, followed by drug-induced skin conditions and, at a much lower rate, cutaneous neoplasms.^{3,6,9} Large Western cohorts and registry studies consistently identify non-melanoma skin cancers (squamous cell carcinoma and basal cell carcinoma) as the single most common post-transplant malignancy, with cumulative non-melanoma skin cancer incidence reaching >20-50% over decades and with strongly elevated standardized incidence ratios compared to the general population.¹⁰ By contrast, multiple studies from East Asia and the Middle East report lower absolute incidence of non-melanoma skin cancer after transplantation. Although the relative risk compared with the local general population remains elevated, this geographic heterogeneity is attributed to differences in skin phototype, ultraviolet radiation exposure, genetic susceptibility, and local oncogenic infections.¹¹

Although the number of RTRs in Saudi Arabia is increasing, local data on their prevalence and clinical presentation remain inadequate. Moreover, graft function and systemic outcomes have been the focus of most studies, while cutaneous manifestations have been overlooked, potentially delaying diagnosis, leading to inadequate therapy, and impacting long-term quality of life. Given these gaps, there is a pressing need to advance early detection of dermatologic conditions, management strategies, and comprehensive care during the post-transplant phase. This study aims to evaluate the prevalence of dermatologic conditions among RTRs, as well as the related clinical features and outcomes at a tertiary medical hospital in Saudi Arabia.

Methods

Ethical Consideration

King Abdullah International Medical Research Centre (KAIMRC) ethics approval was obtained with reference number NRR25/032/8. All transplanted kidneys were obtained through voluntary donation with written informed consent, and the transplantation procedures were conducted in accordance with the ethical principles outlined in the Declaration of Istanbul.

Study Setting and Design

This retrospective cross-sectional study was conducted at King Abdulaziz Medical City, National Guard Health Affairs (KAMC-NGHA), Riyadh, Saudi Arabia. KAMC-NGHA is a leading tertiary care center with an established renal transplantation program that offers comprehensive post-transplant care through specialized nephrology and dermatology clinics. The BESTCare electronic medical record system, which maintains detailed longitudinal clinical documentation for RTRs, was used to retrieve patients' data.

Selection Criteria

A total of 338 RTRs who visited the dermatology department from 2015 to 2025 at KAMC-NGHA were included. Inclusion criteria included adult RTRs aged 18 years or older who had at least one documented dermatology consultation during post-transplant follow-up. Exclusion criteria were incomplete dermatologic documentation, a history of multi-organ transplantation, or dermatologic diagnoses established outside KAMC-NGHA without sufficient clinical records.

Data Collection

Data were systematically extracted from the Ministry of National Guard Health Affairs medical record system (BESTCare). Collected data were classified into four categories: demographic, transplant-related, dermatologic-related, and treatment-related variables. Data regarding the age at transplantation, the age at onset of dermatologic conditions, and gender were included in the demographics. The transplant-related variables included donor type, time from transplantation to dermatologic diagnosis, induction and maintenance immunosuppressive regimens, as well as the number of immunosuppressive agents administered. Dermatologic data included the type of skin condition (categorized as infectious, inflammatory, drug-induced, neoplastic, hair disorders, nail disorders, and other dermatologic conditions), and the diagnostic methods used were recorded. Treatment-related variables included the type of therapy administered and clinical outcomes, classified as resolution, persistence, recurrence, or unknown.

Statistical Analysis

We analyzed the collected data using SPSS 27.0 (IBM Corp., Armonk, NY). Continuous data were presented as the arithmetic mean $\pm$ standard deviation (SD) or median. Discrete data were presented as frequencies and percentages. The normality of continuous data was evaluated through the Shapiro–Wilk test. Associations between categorical variables and treatment outcomes were assessed using the chi-square test. We applied Fisher’s exact test when expected cell counts were less than five. Furthermore, multinomial logistic regression was performed to identify the factors associated with dermatologic conditions. The significance level was set as $p < 0.05$.

Results

Patient Characteristics

This study included a total of 338 RTRs. The demographic characteristics of these patients are detailed in [Table 1](#). The cohort included 164 (48.5%) males and 174 (51.5%) females. Patient ages ranged from 18 to 74 years, with a mean age of 34.96 ± 15.64 years. Kidney transplants were obtained from living-related, living-unrelated, and deceased donors, accounting for 126 (38.3%), 116 (35.3%), and 87 (26.4%) cases, respectively.

Table 1 Demographics of Renal Transplant Recipients (N = 338)

Demographic Variable		Mean (Median)	Frequency	Percent
Gender	Male		164	48.5
	Female		174	51.5
Age at transplant (years)		34.96 (33.0)		
Dermatologic manifestations count		1.40 (1.0)		
Transplant-to-Dermatologic Diagnosis Interval (years)		6.24 (4.0)		
Donor type	Living related		126	38.3
	Living unrelated		116	35.3
	Deceased		87	26.4
Induction therapy utilized	Basiliximab		91	51.7
	Thymoglobulin		61	34.7
	Basiliximab + Rituximab		1	0.6
	No therapy		23	13.1

(Continued)

Table 1 (Continued).

Demographic Variable		Mean (Median)	Frequency	Percent
Maintenance therapy	Tacrolimus		305	90.2
	Cyclosporine		21	16.9
	Mycophenolate		281	83.1
	Azathioprine		29	8.6
	Sirolimus		1	0.3
	Steroid		309	91.4

Induction immunosuppression was administered to most patients. Basiliximab was the most used agent, given to 91 (51.7%) patients, followed by thymoglobulin in 61 (34.7%). A combination of basiliximab and rituximab was used in 1 (0.6%) patient, whereas 23 (13.1%) patients did not receive induction therapy.

With the exception of 6 (1.8%) patients, all patients were maintained on immunosuppressive therapy to prevent graft rejection. Combination maintenance therapy was used among 322 (95.3%) patients, while only 10 (3.0%) received monotherapy. The most utilized maintenance immunosuppressant drugs were steroids 309 (91.4%), tacrolimus 305 (90.2%), and mycophenolate 281 (83.1%). Sirolimus was rarely used, with only 1 (0.3%) patient receiving it in combination with other immunosuppressants. Other regimens that were utilized in combination with the most utilized maintenance therapies were cyclosporine 21 (16.9%) and azathioprine 29 (8.6%).

Prevalence and Spectrum of Dermatologic Conditions

The prevalence and spectrum of dermatologic conditions identified in RTRs are detailed in [Table 2](#). The most frequently observed conditions were infectious 126 (37.3%), followed by inflammatory 81 (24.0%), drug-induced 42 (12.4%), hair disorders 40 (11.5%), neoplastic 20 (5.9%), nail disorders 4 (1.2%), and other dermatologic conditions 24 (7.1%).

The most common infectious conditions diagnosed were viral warts 52 (41.3%), superficial fungal infections 23 (18.3%), and folliculitis 21 (16.7%). Inflammatory skin conditions were predominantly acne vulgaris 34 (42.0%), lichen simplex chronicus 16 (19.8%), and prurigo nodularis 9 (11.1%).

Table 2 Dermatologic Conditions Distribution Among Renal Transplant Patients

Category	Condition	n (%)
Infectious (n=126)	Viral warts	52 (41.3)
	Tinea (superficial fungal)	23 (18.3)
	Folliculitis	21 (16.7)
	Molluscum contagiosum	9 (7.1)
	Herpes zoster	8 (6.3)
	Intertrigo	8 (6.3)
	Ecchyma	4 (3.2)
	Scabies	1 (0.8)

(Continued)

Table 2 (Continued).

Category	Condition	n (%)
Inflammatory (n=81)	Acne vulgaris	34 (42.0)
	Lichen simplex chronicus	16 (19.8)
	Prurigo nodularis	9 (11.1)
	Seborrheic dermatitis	5 (6.2)
	Lichen planus	5 (6.2)
	Hidradenitis suppurativa	3 (3.7)
	Psoriasis	3 (3.7)
	Vitiligo	3 (3.7)
	Urticaria	1 (1.2)
	Rosacea	1 (1.2)
	Pemphigus vulgaris	1 (1.2)
Neoplastic (n=20)	Seborrheic keratosis	7 (35.0)
	Squamous cell carcinoma	6 (30.0)
	Basal cell carcinoma	4 (20.0)
	Kaposi sarcoma	2 (10.0)
	Lentigo	1 (5.0)
Drug-induced (n=42)	Steroid-induced acne	37 (88.1)
	Drug-induced pruritus	4 (9.5)
	Fixed drug eruption	1 (2.4)
Hair disorders (n=40)	Telogen effluvium	17 (42.5)
	Alopecia areata	13 (32.5)
	Androgenetic alopecia	10 (25.0)
Nail disorders (n=4)	Onychomycosis	4 (100)
Other (n=24)	Xerosis	11 (45.8)
	Pruritus	9 (37.5)
	Keloids	3 (12.5)
	Hyperhidrosis	1 (4.2)

Neoplastic conditions varied among patients, with seborrheic keratosis and squamous cell carcinoma being the most common, accounting for 7 (35.0%) and 6 (30.0%) cases, respectively. Among drug-induced dermatologic manifestations, steroid-induced acne was the most prevalent, observed in 37 (88.1%) patients.

Hair disorders were primarily represented by telogen effluvium 17 (42.5%), alopecia areata 13 (32.5%), and androgenetic alopecia 10 (25.0%). Nail disorders were infrequently observed, with onychomycosis reported in 4 (100%) patients. Other dermatologic conditions included xerosis 11 (45.8%), pruritus 9 (37.5%), keloids 3 (12.5%), and hyperhidrosis 1 (4.2%).

Association of Clinical and Demographic Factors with Dermatologic Conditions

Regression analysis demonstrated a strong association between age and dermatologic manifestations among RTRs ($\chi^2 = 57.32$, $p < 0.001$). Each additional year of age was associated with a 10% increase in the odds of neoplastic conditions compared with infectious dermatologic conditions (OR = 1.10, $p < 0.001$) Table 3.

Sex was also significantly associated with dermatologic manifestations among RTRs ($\chi^2 = 16.96$, $p = 0.009$). Male patients had higher odds of inflammatory dermatologic conditions compared with infectious conditions than female patients (OR = 1.30). Similarly, female patients were 4.16 times more likely to experience hair disorders compared with male patients.

Time from transplantation to dermatologic diagnosis ($p = 0.99$) and donor type ($p = 0.75$) were not significantly associated with dermatologic condition types among RTRs.

Table 3 Clinical and Demographic Factors Associated with Dermatologic Conditions

Dermatologic Condition*	Factor	OR	95% CI (Lower-Upper)	p-value
Inflammatory	Age	0.97	0.95–0.99	0.002
	Sex	1.30	0.73–2.33	0.021
	Time from transplant to dermatology diagnosis	0.96	0.95–1.04	0.83
	Donor type	0.99	0.67–1.44	0.96
Neoplastic	Age	1.10	1.05–1.15	<0.001
	Sex	0.66	0.22–2.00	0.46
	Time from transplant to dermatology diagnosis	0.99	0.91–1.07	0.73
	Donor type	0.64	0.32–1.30	0.22
Drug-induced	Age	0.96	0.96–1.01	0.003
	Sex	1.35	0.92–2.77	0.41
	Time from transplant to dermatology diagnosis	0.98	0.92–1.05	0.57
	Donor type	0.87	0.55–1.38	0.55
Hair disorder	Age	0.98	0.96–1.01	0.15
	Sex	4.16	1.82–9.53	0.001
	Time from transplant to dermatology diagnosis	0.99	0.93–1.05	0.74
	Donor type	1.08	0.68–1.71	0.75
Nail disorder	Age	1.05	0.98–1.12	0.17
	Sex	5.44	0.57–51.44	0.14
	Time from transplant to dermatology diagnosis	1.00	0.88–1.15	0.94
	Donor type	1.06	0.34–3.28	0.93
Other	Age	1.02	0.97–1.05	0.29
	Sex	1.07	0.43–2.70	0.88
	Time from transplant to dermatology diagnosis	0.97	0.90–1.05	0.50
	Donor type	1.30	0.73–2.30	0.38

Note: *infectious condition type was the reference category.

Abbreviations: CI, Confidence Interval; OR, Odds Ratio.

Table 4 Correlation Between Treatment Types and Diagnostic Modalities and Treatment Outcomes

		N (%)	Treatment Outcomes, N (%)				p-value
			Resolved	Persistent	Recurrent	Unknown	
Diagnostic modality	Clinical	293 (86.7)	94 (32.6)	31 (10.8)	9 (3.1)	154 (53.5)	0.040
	Histopathology	29 (8.6)	13 (44.8)	1 (3.4)	2 (6.9)	13 (44.8)	
	Multiple	10 (3.0)	1 (10.0)	2 (20.0)	0 (0.0)	7 (70.0)	
	Culture/microscopy	6 (1.8)	6 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	
Treatment type	Topical	243 (72.1)	82 (34.0)	24 (10.0)	4 (1.7)	131 (54.4)	0.035
	Combined	59 (17.5)	18 (31.6)	8 (14.0)	4 (7.0)	27 (47.4)	
	Surgical	18 (5.3)	10 (56.6)	1 (5.6)	1 (5.6)	6 (33.3)	
	Systemic	11 (3.3)	4 (36.4)	0 (0.0)	2 (18.2)	5 (45.4)	
	None	6 (1.8)	0 (0.0)	1 (16.7)	0 (0.0)	5 (83.3)	

Abbreviation: N, Number.

Correlation Between Diagnostic Modalities, Management Approaches, and Treatment Outcomes for Dermatologic Conditions

Various diagnostic methods were used to establish dermatologic diagnoses. The majority of dermatologic diagnoses were established through clinical examination, representing 293 (86.7%) of evaluations. Besides, dermatologic management varied across patients, with topical interventions being the most used treatment modality, administered in 243 (72.1%) cases [Table 4](#).

Treatment outcomes varied among patients. Resolution of dermatologic manifestations was observed in 114 (34.23%) cases, while persistence and recurrence were reported in 34 (10.21%) and 11 (3.30%) cases, respectively [Figure 1](#).

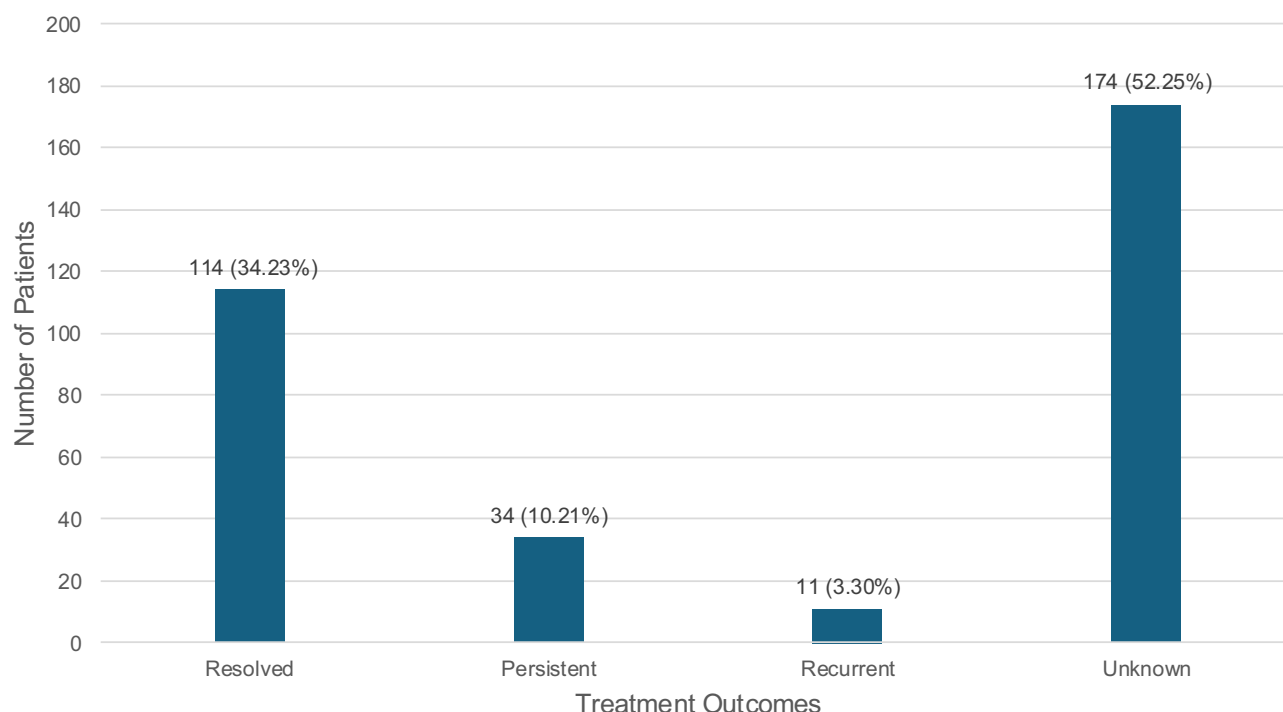


Figure 1 Treatment outcomes for dermatologic conditions among renal transplant patients. Resolved: complete resolution of conditions; Recurrent: partial resolution of conditions; Persistent: no significant clinical improvement; Unknown: outcome could not be ascertained due to indeterminate clinical status.

Treatment outcomes differed according to diagnostic modality, with a statistically significant association observed between diagnostic approach and clinical outcomes (Fisher's Exact Test, $p = 0.040$). A higher proportion of resolved outcomes was observed among patients diagnosed through clinical examination 94 (32.6%) compared with other diagnostic modalities. Similarly, treatment type was significantly associated with dermatologic outcomes (Fisher's Exact Test, $p = 0.035$) (Table 4). Resolution was more frequently observed among patients managed with topical therapy compared with those receiving systemic or surgical treatments Table 4.

Discussion

This retrospective analysis of 338 RTRs provides a comprehensive characterization of the dermatological burden in RTRs, demonstrating that immunosuppressive therapy may profoundly influence both the incidence and clinical behavior of cutaneous conditions in this population. Infectious conditions were most prevalent (37.3%), followed by inflammatory conditions (24.0%), drug-induced conditions (12.4%), hair disorders (11.5%), and neoplastic conditions (5.9%). Increasing age was independently associated with higher odds of neoplastic conditions, while sex-specific patterns emerged, with males showing higher odds of inflammatory conditions and females demonstrating significantly higher odds of hair disorders. These findings underscore the need for risk-stratified dermatologic surveillance in RTRs and highlight the complex interplay between immunosuppression and cutaneous homeostasis.

The predominance of infectious dermatologic conditions, particularly viral warts (41.3% of infections) and superficial fungal infections (18.3%) reflects the direct consequence of chronic immunosuppression on cell-mediated immunity. Calcineurin inhibitors (tacrolimus in 90.2% of patients) and antimetabolites (mycophenolate in 83.1%) selectively impair T-lymphocyte function by inhibiting interleukin-2 production and lymphocyte proliferation, respectively, thereby compromising host defense mechanisms crucial for controlling viral and fungal pathogens.^{12–14} This immunological vulnerability not only increases susceptibility to initial infection but also complicates treatment, as immune-mediated clearance mechanisms are impaired. Clinically, viral warts in RTRs often present with greater extent and higher recurrence rates, while superficial fungal infections may exhibit atypical morphology with a reduced inflammatory response, potentially delaying diagnosis.¹⁵ The high prevalence of folliculitis (16.7% of infections) and intertrigo (6.3%) additionally highlight the importance of routine skin hygiene counseling and early intervention for minor cutaneous disruptions that might otherwise progress in immunocompromised hosts.^{12–14} Clinicians should maintain a low threshold for diagnostic confirmation through bacterial culture and potassium hydroxide preparation, and anticipate that standard treatment courses may require extended duration or combination therapy.¹⁶

Inflammatory dermatoses, particularly acne vulgaris (42.0% of inflammatory conditions), represent a distinct diagnostic and therapeutic challenge in the transplant population. While immunosuppressive therapy might theoretically ameliorate certain inflammatory conditions such as psoriasis (observed in only 3.7% of inflammatory cases), steroid-induced acne, the most common drug-induced manifestation (88.1%), demonstrates that immunosuppressive agents themselves can provoke inflammatory responses. This paradoxical effect may be explained by corticosteroid-induced alterations in follicular hyperkeratinization and sebum composition, typically presenting as monomorphic papules and pustules on the chest, back, and shoulders, 2–6 weeks after high-dose steroid administration.^{17,18} Management requires balancing dermatologic control against graft preservation, with first-line therapy including topical retinoids and benzoyl peroxide, while systemic antibiotics, particularly tetracyclines, require caution due to potential interactions with calcineurin inhibitors.¹⁹ Moreover, lichen simplex chronicus (19.8%) and prurigo nodularis (11.1%) emerged as unexpectedly common inflammatory dermatoses, likely exacerbated by transplant-specific factors including xerosis from calcineurin inhibitors, neuropathic pruritus associated with chronic kidney disease, and psychological stress related to transplantation.^{3,9}

The association between male sex and higher odds of inflammatory conditions (OR = 1.30, $p = 0.021$) may reflect gender differences in occupational ultraviolet exposure, healthcare-seeking behavior, or hormonal influences on cutaneous inflammation, with testosterone known to modulate sebaceous gland activity and inflammatory cytokine production.²⁰ This gender disparity has been noted extensively across the literature with a 2000–2019 survey on cancer surveillance, epidemiology, and end-results by Tosakoon et al highlighting a 2–3-fold susceptibility to non-specific cancers compared to females, although this difference remains poorly understood.²¹

Hair disorders emerged as a significant finding, with female RTRs 4.16 times more likely to develop these conditions (95% CI, 1.82–9.53; $p = 0.001$), predominantly telogen effluvium (42.5%) and alopecia areata (32.5%). This under-recognized post-transplant morbidity likely arises from multiple mechanisms: telogen effluvium can be precipitated by surgical stress, postoperative nutritional deficiencies (particularly iron and zinc), acute illness, and medications including calcineurin inhibitors.²² On the other hand, alopecia areata, as an autoimmune disorder, may be influenced by the selective T-cell-targeted immunosuppression that incompletely controls complex autoimmune pathways.²³ Furthermore, androgenetic alopecia (25.0%) may be unmasked by the stress of transplantation or by medication effects on hair follicle cycling.²⁴ The higher baseline prevalence of autoimmune disorders in females likely contributes to the observed sex difference. Clinically, these findings emphasize the need to proactively inquire about hair changes during follow-up visits, as patients may not voluntarily report these concerns despite significant quality-of-life impact.

The age-dependent increase in neoplastic conditions, with each additional year conferring 10% higher odds of neoplasms compared to infectious conditions (OR = 1.10, 95% CI, 1.05–1.15; $p < 0.001$), carries important clinical implications for surveillance protocols. This finding likely reflects the convergence of cumulative ultraviolet-induced DNA damage over decades, age-related decline in DNA repair capacity, and longer duration of immunosuppression creating a permissive environment for malignant transformation.²⁵ Notably, the transplant-to-dermatologic diagnosis interval was not significantly associated with neoplastic risk ($p = 0.73$), suggesting that age itself, as a proxy for cumulative lifetime exposures and intrinsic biological changes may be more clinically useful for risk stratification than post-transplant duration alone. The spectrum of neoplasms observed, including seborrheic keratosis (35.0%), squamous cell carcinoma (30.0%), basal cell carcinoma (20.0%), Kaposi sarcoma (10.0%), and lentigo (5.0%), reflects the unique oncologic profile of immunosuppressed populations. While non-melanoma skin cancers were less prevalent than in Western cohorts, consistent with the protective effect of darker skin phototypes in this Saudi population, the occurrence of any malignancy in relatively young RTRs (mean age 34.96 years) is clinically significant.²⁶ Crucially, the observed spectrum from benign seborrheic keratosis to malignant progression to SCC highlights the overarching necessity for vigilant, long-term dermatologic surveillance, aligning with observations from a previous immunohistochemical analysis of eleven benign seborrheic keratosis by Goto et al.²⁷

Drug-induced conditions accounted for 12.4% of dermatologic diagnoses, with steroid-induced acne predominating (88.1%), reflecting the near-universal use of corticosteroids in maintenance immunosuppression (used in 91.4% of patients). Drug-induced pruritus (9.5%) and fixed drug eruption (2.4%) were also observed. Drug-induced pruritus may arise from direct histamine release, cholestatic effects, or hypersensitivity reactions, requiring identification and, where possible, the substitution of the offending agent, though this is often limited by the necessity of immunosuppressive therapy.²⁸

Nail disorders were infrequently observed (1.2%), with onychomycosis accounting for all cases. This low prevalence may reflect underreporting or under-documentation, yet onychomycosis in RTRs warrants attention because it serves as a reservoir for fungal organisms, may be more resistant to topical therapies, and can be mistaken for other nail dystrophies. Other dermatologic conditions included xerosis (45.8% of “other” category), pruritus without primary lesions (37.5%), keloids (12.5%), and hyperhidrosis (4.2%). Xerosis is particularly common due to calcineurin inhibitor-induced sebaceous gland suppression and diuretic use, potentially leading to asteatotic eczema requiring intensive emollient therapy and avoidance of harsh soaps. According to Weissshaar et al and Tarikci et al, pruritus without primary lesions presents a diagnostic challenge requiring the exclusion of systemic causes (cholestasis, chronic kidney disease, and hematologic disorders) before attributing it to medication or xerosis.^{29,30}

Additionally, this study’s secondary objective was aimed at determining the association between management approaches and clinical outcomes. In this light, regression analysis revealed a statistically significant correlation (Fisher’s Exact Test, $p = 0.035$), with key observations highlighting the association of topical therapy with the highest absolute number of resolved cases ($n = 82$) and within its treatment group, 34.0% of cases had a documented resolved outcome. Despite the large (54.4% for topical therapy) “unknown” outcome category, limiting definitive conclusions, patterns realized from these results suggest that for many post-transplant dermatoses, such as superficial fungal infections, viral warts, acne, and xerosis, targeted topical treatments are effective first-line interventions based on their typical association with fewer systemic side effects and drug interactions.^{3,9}

In contrast, systemic and surgical interventions, while necessary for conditions like advanced SCC or severe inflammatory disorders, were applied to fewer patients and showed varied outcome patterns. Observations from these interventions, for instance, surgical intervention had a high resolution rate (56.6% within this group) but was used in only 18 patients, predominantly for neoplastic excisions, while the “combined” therapy group had a resolution rate of 31.6%, indicating that more complex or refractory conditions often require multimodal approaches. Despite these interventions, the overall persistence (10.21%) and recurrence (3.30%) highlight the chronic and relapsing nature of many dermatologic conditions in RTRs, likely fueled by the persistent iatrogenic immunosuppression.

To optimally address the dermatological burden presenting in RTRs, this study acknowledges several limitations requiring careful consideration when interpreting its findings. Firstly, the retrospective and single-center design may limit the generalizability of the findings. Moreover, the high proportion of outcomes categorized as “unknown” (ie, outcomes that could not be ascertained due to indeterminate clinical status) introduces potential bias and weakens the strength of conclusions regarding treatment efficacy. Nevertheless, this had no impact on analyzing the correlation between treatment type and treatment response. As a result, only three outcomes were given priority during the correlation analysis (persistent, recurrent, and resolved). This study’s failure to adjust for the intensity or duration of specific immunosuppressive regimens (beyond induction and maintenance drug categories) presents a significant confounder, especially for drug-induced manifestations like steroid-induced acne ($n = 37$). Finally, the cross-sectional nature of the prevalence data also makes it difficult to establish true causality between identified risk factors and dermatologic outcomes.

Conclusion

Conclusively, this study delineates a significant dermatologic burden in RTRs, predominantly characterized by immunosuppression-driven infectious and inflammatory conditions. Through identifying strong predictors for neoplastic transformation, such as increased age and male gender, this analysis provides a valuable tool for risk stratification, suggesting that these subgroups may benefit from prioritized and more frequent dermatologic screening. Moreover, the association between topical therapy and favorable resolution outcomes supports a treatment paradigm that prioritizes targeted, localized interventions where clinically appropriate, minimizing systemic complications.

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Data Sharing Statement

All data generated or analyzed during this study are included in this article.

Ethical Approval and Informed Consent

This study was conducted in accordance with the Declaration of Helsinki. Ethical approval was obtained from the King Abdullah International Medical Research Centre (KAIMRC), the Institutional Review Board of the Ministry of National Guard Health Affairs, including King Abdulaziz Medical City, Riyadh, Saudi Arabia, under reference number NRR25/032/8. Before accessing the data from medical records, all data were fully de-identified. The study employed a retrospective design using data extracted from the BESTCare electronic medical record system, and no direct patient contact was involved. Therefore, the Institutional Review Board waived the requirement for written informed consent. The privacy and confidentiality of patients’ medical records were maintained; no identifying information was included, and the data were securely handled. All transplanted kidneys were obtained through voluntary donation with written informed consent, and the transplantation procedures were conducted in accordance with the ethical principles outlined in the Declaration of Istanbul.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically

reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Disclosure

The authors have no conflict of interest to disclose for this work.

References

1. Alshehri MA, Alkhlady HY, Awan ZA, et al. Prevalence of chronic kidney disease in Saudi Arabia: an epidemiological population-based study. *BMC Nephrol.* 2025;26(1):37. doi:10.1186/s12882-025-03954-2
2. Fitzpatrick J, Chmelo J, Nambiar A, et al. Recipient outcomes in total laparoscopic live donor nephrectomy with multiple renal vessels. *Urol Ann.* 2020;12(3):266–270. doi:10.4103/UA.UA_96_19
3. Oh CC, Lee HY, Tan BK, et al. Dermatological conditions seen in renal transplant recipients in a Singapore tertiary hospital. *Singapore Med J.* 2018;59(10):519–523. doi:10.11622/smedj.2018126
4. Statista. Total global kidney transplants by region 2023. Available from: <https://www.statista.com/statistics/398657/kidney-transplants-by-world-region/>. Accessed January 20, 2026.
5. Saudi Center for Organ Transplantation. Annual Reports. Available from: <https://www.scot.gov.sa/en/reports-and-statistics/annual-reports>. Accessed January 20, 2026.
6. Dziri S, Azzabi A, Tlili G, et al. Dermatological conditions seen in kidney transplant recipients: prevalence and risk factors. *Exp Clin Transplant.* 2024;22(Suppl 1):310–314. doi:10.6002/ect.MESOT2023.P108
7. Fishman JA. Infection in organ transplantation. *Am J Transplant.* 2017;17(4):856–879. doi:10.1111/ajt.14208
8. Shope C, Andrews L, Leath MN, Linkous C, Lee LW. Identifying risk factors for cutaneous disease among solid organ transplant recipients: a retrospective review. *JAAD Int.* 2023;11:157–164. doi:10.1016/j.jdin.2023.02.003
9. Vieira EC, Marcolino MS, Guedes ACM, et al. Frequency of skin diseases in renal transplant recipients and patients with chronic kidney disease in a tertiary center: a cross-sectional study. *Sao Paulo Med J.* 2024;142(4):2023148. doi:10.1590/1516-3180.2023.0148.R1.29112023
10. Euvrard S, Kanitakis J, Claudy A. Skin cancers after organ transplantation. *N Engl J Med.* 2003;348(17):1681–1691. doi:10.1056/NEJMra022137
11. Park GH, Chang SE, Won CH, et al. Incidence of primary skin cancer after organ transplantation: an 18-year single-center experience in Korea. *J Am Acad Dermatol.* 2014;70(3):465–472. doi:10.1016/j.jaad.2013.10.024
12. Asgari MM, Tsai AL, Avalos L, Sokil M, Quesenberry CP. Association between topical calcineurin inhibitor use and keratinocyte carcinoma risk among adults with atopic dermatitis. *JAMA Dermatol.* 2020;156(10):1066. doi:10.1001/jamadermatol.2020.2240
13. Seviiri M, Law MH, Ong JS, et al. Polygenic risk scores stratify keratinocyte cancer risk among solid organ transplant recipients with chronic immunosuppression in a high ultraviolet radiation environment. *J Invest Dermatol.* 2021;141(12):2866–2875.e2. doi:10.1016/j.jid.2021.03.034
14. Crow LD, Kaizer-Salk KA, Juszczak HM, Arron ST. Medications associated with increased risk of keratinocyte carcinoma. *Dermatol Clin.* 2019;37(3):297–305. doi:10.1016/j.det.2019.02.005
15. Matei C, Diaconu LS, Tampa M. Interleukins in the pathogenesis of warts: insight from the last decade—A narrative review. *JCM.* 2025;14(6):2057. doi:10.3390/jcm14062057
16. Lei V, Petty AJ, Atwater AR, Wolfe SA, MacLeod AS. Skin viral infections: host antiviral innate immunity and viral immune evasion. *Front Immunol.* 2020;11:593901. doi:10.3389/fimmu.2020.593901
17. Ulrich P, Drexler K, Berneburg M, Kurz B, Niebel D. Acneiform Drug Eruptions-Update on Pathophysiology and Culprit Drugs. *Front Med.* 2026;13:1769362. doi:10.3389/fmed.2026.1769362
18. Woo YR, Kim HS. Truncal acne: an overview. *J Clin Med.* 2022;11(13):3660. doi:10.3390/jcm11133660
19. Castello M, Gregorini M, Rampino T, et al. A retrospective analysis of dermatological lesions in kidney transplant patients. *Ind J Med Res.* 2013;137(6):1188–1192.
20. Buxeda A, Redondo-Pachón D, Pérez-Sáez MJ, et al. Gender differences in cancer risk after kidney transplantation. *Oncotarget.* 2019;10(33):3114–3128. doi:10.18632/oncotarget.26859
21. Tosakoon S, Lawrence WR, Shiels MS, Jackson SS. Sex differences in cancer incidence rates by race and ethnicity: results from the surveillance, epidemiology, and end results (SEER) registry (2000–2019). *Cancers.* 2024;16(5):989. doi:10.3390/cancers16050989
22. Asghar F, Shamim N, Farooque U, Sheikh H, Aqeel R. Telogen effluvium: a review of the literature. *Cureus.* 2020;12(5):e8320. doi:10.7759/cureus.8320
23. Ma T, Zhang T, Miao F, et al. Alopecia areata: pathogenesis, diagnosis, and therapies. *MedComm.* 2025;6(5):e70182. doi:10.1002/mco2.70182
24. Ho CH, Sood T, Zito PM. Androgenetic Alopecia. In: *StatPearls*. StatPearls Publishing; 2026 <http://www.ncbi.nlm.nih.gov/books/NBK430924/>. Accessed March 20, 2026.
25. Bakker D, Bakker WJ, Bekkenk MW, Luiten RM. Immunity against non-melanoma skin cancer and the effect of immunosuppressive medication on non-melanoma skin cancer risk in solid organ transplant recipients. *Cells.* 2023;12(20):2441. doi:10.3390/cells12202441
26. Miyamura Y, Coelho SG, Wolber R, et al. Regulation of human skin pigmentation and responses to ultraviolet radiation. *Pigment Cell Res.* 2007;20(1):2–13. doi:10.1111/j.1600-0749.2006.00358.x
27. Goto K, Ogawa K, Hishima T, et al. Seborrheic keratosis with malignant transformation: a clinicopathologic and immunohistochemical study of 11 cases. *Am J Dermatopathol.* 2022;44(12):891–899. doi:10.1097/DAD.0000000000002245
28. Nakao Y, Asada M, Uesawa Y. Comprehensive study of drug-induced pruritus based on adverse drug reaction report database. *Pharmaceuticals.* 2023;16(10):1500. doi:10.3390/ph16101500
29. Tarıkci N, Kocatürk E, Güngör Ş, Oğuz Topal I, Ülkümen Can P, Singer R. Pruritus in systemic diseases: a review of etiological factors and new treatment modalities. *Scient World J.* 2015;2015:803752. doi:10.1155/2015/803752
30. Weisshaar E, Müller S, Szepietowski JC, et al. European S2k guideline on chronic pruritus: in cooperation with the european dermatology forum (EDF). *Acta Dermato-Venereologica.* 2025;105:adv44220. doi:10.2340/actadv.v105.44220

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