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Research Article

ACR TI-RADS for Incidental Thyroid Lesions in Iraqi Patients Post Renal Transplants: A Single Center Study

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Abstract

Background: Long-term immunosuppression following renal transplantation has been linked to thyroid dysfunction and malignancy. However, data on thyroid nodule prevalence and characteristics in transplant recipients remain limited. ***Objective***: To screen in RT recipients, stratifying nodule malignancy risk using the TI-RADS reporting system. ***Methods***: A cross-sectional study evaluated thyroid nodules in 166 clinically euthyroid renal transplant recipients attending routine follow-up at the Transplant Center, Medical City, compared with 221 age- and sex-matched healthy controls. All participants underwent standardized ultrasound using the American College of Radiology Thyroid Imaging Reporting and Data System classification. Of 39 nodules biopsied, 14 were malignant and 25 benign. ***Results***: The mean age of RT recipients was 42±12 years, with males comprising 77.7%. Incidental thyroid nodules were identified in 42.2% compared to 31.2% in the controls. Among transplant recipients, 51.4% of nodules were solitary and 48.6% were multiple. Following TIRADS classification, TIRADS-3 was reported in 9.6% of mildly suspicious nodules, while 11.4% of the nodules were moderately suspicious TIRADS-4, and 1.8% were highly suspicious TIRADS-5. Malignancy was confirmed in 10% of biopsied nodules. TIRADS stratification demonstrated a statistically significant association with malignancy, while other demographic and clinical variables, including immunosuppressive regimen, were not predictive. The ultrasound features of nodules in the transplant group were comparable to those observed in healthy controls. ***Conclusions***: Thyroid nodule prevalence and malignancy risk in renal transplant recipients resemble the general population; immunosuppression may not be a key factor, but ACR-TIRADS surveillance supports early selective detection.

Keywords: Incidental thyroid nodule; Immunosuppression; Renal transplant.

ACR TI-RADS لآفات الغدة الدرقية العرضية لدى المرضى العراقيين بعد زراعة الكلى: دراسة في مركز واحد

الخلاصة

الخلفية: تم ربط تثبيط المناعة طويل الأمد بعد زراعة الكلى بخلل الغدة الدرقية والسرطان. ومع ذلك، لا تزال البيانات حول انتشار وخصائص عقد الغدة الدرقية لدى متلقي الكلى محدودة. **الهدف**: فحص مرضى زراعة الكلى، وتصنيف مخاطر العقيدات الخبيثة باستخدام نظام الإبلاغ TI-RADS. **الطرائق**: أجريت دراسة مقطعية لتقييم عقيدات الغدة الدرقية لدى 166 متلقيا طبيعي الغدة سريريا وخضعوا لزراعة كلوية والذين حضروا لمتابعة روتينية في مركز الزراعة بالمدينة الطبية، مقارنة ب 221 ضابطا صحيا متطابقا من حيث العمر والجنس. خضع جميع المشاركين لفحص الموجات فوق الصوتية الموحد باستخدام تصنيف الكلية الأمريكية لعلم الأشعة وتصنيف نظام التصوير والبيانات للغدة الدرقية. من بين 39 عقدة تم تصويرها، كانت 14 خبيثة و25 حميدة. **النتائج**: كان متوسط عمر المتلقين للكلى 42±12 سنة، ويمثل الذكور 77.7٪. تم تحديد عقيدات الغدة الدرقية العرضية في 42.2٪ مقارنة ب 31.2٪ في المجموعة الضابطة. من بين متلقي الزراعة، كان 51.4٪ من العقيدات منفردة و48.6٪ متعددة. بعد تصنيف TIRADS، تم الإبلاغ عن TIRADS-3 في 9.6٪ من العقيدات المشبوهة قليلا، بينما كانت 11.4٪ من العقيدات TIRADS-4 مشبوهة إلى حد متوسط، و1.8٪ كانت TIRADS-5 شديدة الريبة. تم تأكيد وجود عقد خبيثة في 10٪ من العقيدات التي تم تصويرها بالخزعة. أظهرت الطبقات المصنفة ل TIRADS ارتباطا ذا دلالة إحصائية مع الأورام الخبيثة، بينما لم تكن المتغيرات الديموغرافية والسريرية الأخرى، بما في ذلك النظام المثبط للمناعة، تنبؤية. كانت ميزات الموجات فوق الصوتية للعقيدات في مجموعة الزرع مشابهة لتلك التي لوحظت في مجموعة ضابطات صحية. **الاستنتاجات**: انتشار عقد الغدة الدرقية وخطر الإصابة بالأورام الخبيثة لدى متلقي زراعة الكلى يشبه عموم الأشخاص؛ قد لا يكون تثبيط المناعة عاملا رئيسيا، لكن مراقبة ACR-TIRADS تدعم الكشف الانتقائي المبكر.

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INTRODUCTION

Renal transplantation and its associated long-term immunosuppression have been linked to increased risks of thyroid dysfunction and malignancy [1,2]. The most frequently observed thyroid abnormality in this population is low T3 syndrome with normal thyroid-stimulating hormone (TSH) levels [3], which has demonstrated significant associations with graft survival outcomes [4]. Patients with end-stage renal disease (ESRD) exhibit higher cancer risks during dialysis periods compared to post-transplant intervals [5]. Periodic thyroid function testing is recommended for transplant recipients [2]. Routine thyroid ultrasound screening is not currently standard practice. Asymptomatic and unexpectedly discovered thyroid nodules during an examination of an unrelated physical condition [6], thyroid incidentalomas, are estimated to be between 4 and 7% in clinical practice [7], increasing to 50% when detected by ultrasound

[8]. These incidentally discovered nodules typically show higher probabilities of benignity [9]. In the general population, the malignancy risk of incidentalomas remains relatively low in the absence history of thyroid cancer [10]. A recent screening study of 303 asymptomatic volunteers reported a 33.7% prevalence of thyroid nodules, with approximately one-third classified as moderately suspicious. The Thyroid Imaging Reporting and Data System (TI-RADS) classified 4% of nodules as moderately suspicious and 8% as highly suspicious (TI-RADS 5) [11]. The prevalence and characteristics of thyroid nodules in renal transplant (RT) recipients, however, remain poorly characterized. No previous studies have systematically evaluated the prevalence of incidental thyroid nodules in this high-risk population or compared the potential differences in nodule characteristics compared to healthy controls using TI-RADS classification. Therefore, this study aimed to conduct systematic thyroid ultrasound screening in RT recipients, stratify nodule malignancy risk using the TI-RADS reporting system, and compare findings with an age- and sex-matched healthy control group.

METHODS

Study design and setting

This observational, quantitative, analytic cross-sectional study investigated thyroid nodule prevalence in RT recipients attending the outpatient nephrology clinic at the Renal Disease and Transplant Center, Medical City, Baghdad, for routine post-transplant follow-up. The study cohort was compared to controls to assess potential differences in thyroid nodule characteristics.

Inclusion criteria

Adult RTs recipient due to any reason and clinically euthyroid.

Exclusion criteria

Patient unwilling to undergo thyroid ultrasound examination; pre-existing thyroid disorder diagnosis; abnormal thyroid function tests (TSH, free T4/T3); and clinical evidence or symptoms indicative of thyroid dysfunction.

Sample selection

The sample was 166 eligible renal transplant (RT) patients who attended the outpatient clinic to receive regular post-transplant visits and referrals to the ultrasound department where they were provided with standard types of thyroid ultrasound examinations. The control group was composed of 221 age- and sex-matched individuals with no signs and symptoms of thyroid illness or goiter. These subjects were sent to the ultrasound department, where they were either requested to undergo abdominal scans or pelvic scans, and they willingly participated in the study. The convenience sampling method was used because the study by its nature was limited by the relatively small number of qualified RT patients. There was, however, sufficient match of controls to ensure that the confounding factors were minimized. Sample size was calculated using the formula: $N = Z^2 \times p \times (1-p) \div E^2$. Where: N = sample size; Z = Z-score (based on confidence level); p= estimated proportion (use 0.5 if unknown); E = margin of error; Confidence level: 95% → Z = 1.96. Estimated proportion: p= 0.5; Margin of error: E= 0.076. The sample size is 166.

Data collection and outcome measurement

We collected the following data on all eligible participants in a systematic manner in terms of structured interviews and review of the medical record: Demographic Characteristics: age, sex, body mass index (BMI); Transplant-Specific Parameters: primary etiology of renal failure, date of transplantation, total duration of pre-transplant dialysis, and current immunosuppressive regimen. A thyroid ultrasound study of all subjects was conducted in accordance with the standard procedure of thyroid ultrasound with the assistance of trained radiologists with a GE LOGIC S8 ultrasound system with a high-resolution linear transducer (GE L8-18i, 8-18 MHz). Both axial and longitudinal plans of thyroid glands were studied with the patients lying supine and in the neutral position of the neck. In every case of the identified thyroid nodules, six of the criteria of the ACS-TIRADS classification system were evaluated: maximum dimension, shape, margins, composition, echogenicity, and echogenic foci. These sonographic features enable the stratification of malignancy risk and guide the indications for fine-needle aspiration cytology (FNAC). Based on ACR-TIRADS scoring, each nodule received a cumulative score ranging from 0 to 14, with a minimum threshold score of 4 considered indicative of malignancy risk. In patients with multiple nodules, only the features of the most suspicious nodule were documented for analysis. All patients received comprehensive ultrasound reports, including normal findings. Fine-needle aspiration (FNA) performed for physician-requested cases and nodules meeting ACR TI-RADS size thresholds for biopsy. Among 39 FNA-sampled nodules, 14 were malignant and 25 were benign. Nodules below ACR-recommended size thresholds (n= 100) were presumed clinically benign and managed conservatively with surveillance.

Ethical considerations

This study, which involved human subjects, was approved by the Al-Kindy College of Medicine ethical committee (number 212 on 29-12-2024) and conducted by the principles outlined in the Declaration of Helsinki. All participants provided written informed consent prior to enrollment, confirming their understanding of the study objectives and procedures.

Statistical analysis

All data analyses were performed using SPSS software for Windows, version 25 (IBM Corp., Armonk, NY, USA). Descriptive statistics were reported as frequencies and percentages for categorical variables and as mean ± standard deviation (SD) or range for continuous variables. Group comparisons of nominal and ordinal variables were evaluated using chi-square or Fisher's exact test, as appropriate. For continuous variables, the Mann–Whitney U test was employed due to non-normal distribution. A two-tailed p-value of less than 0.05 was considered statistically significant.

RESULTS

The study enrolled 166 RT recipients with a mean age of 42±12 years, comprising 129 males (77.7%). The median post-transplantation period was 3 months (range: 0-19 months), while the median duration of pre-transplantation dialysis was similarly 3 months (range: 0-16 months). The etiology of renal impairment remained unidentified in 57 cases (34.3%). Among identified causes, hypertension was most prevalent (42 cases, 25.3%), followed by diabetes mellitus (24 cases, 14.5%). All patients received either single or combination immunosuppressant therapy, with details presented in Table 1.

Table 1: Demographics a disease characteristic of renal transplant patients

Characteristics		Values
Age (year) mean±SD(range)		42±12 (19-70)
Sex n(%)	Female	37(22.3)
	Male	129(77.7)
BMI mean±SD(range)		27.39±6.5 (14-38.8)
Duration since RT (m) median(range)		3(0-19)
<6 yeas n(%)		103(62)
≥ 6 years n(%)		63(38)
Time of HD/PD up to transplant (m) mean(range)		3(0-60)
Cause of transplantation n(%)	Unknown	57(34.3)
	Hypertension	42(25.3)
	Diabetes mellitus	24(14.5)
	Systemic lupus erythematosus	5(3)
	Autosomal dominant polycystic kidney disease (ADPKD)	8(4.8)
	nephrotic syndrome	6(2.6)
	Renal stones	4(2.4)
	post covid	4(2.4)
	neurogenic bladder	4(2.4)
	hypovolemic shock	4(2.4)
	Gestational hypertension (GHT)	2(1.2)
	Bilharziasis	2(1.2)
	IgA nephropathy	2(1.2
	NSAID	2(1.2)
Type of immunosuppression used n(%)	Prednisolone	150(90.4)
	Tacrolimus	146(88)
	Mycophenolic acid	81(48.8)
	Cyclosporine	81(48)

Thyroid ultrasound screening revealed incidental thyroid nodules in 70 RT recipients (42.2% prevalence). Among these, 36 patients (51.4%) had a solitary nodule, while 34 (48.6%) presented with multiple nodules. Nodule composition analysis showed cystic morphology in 18 (25.7%) nodules and solid in 34 nodules (48.6%), spongiform texture in 12 (17.1%) nodules, and mixed in 6 (8.5%) nodules (Figure 1).

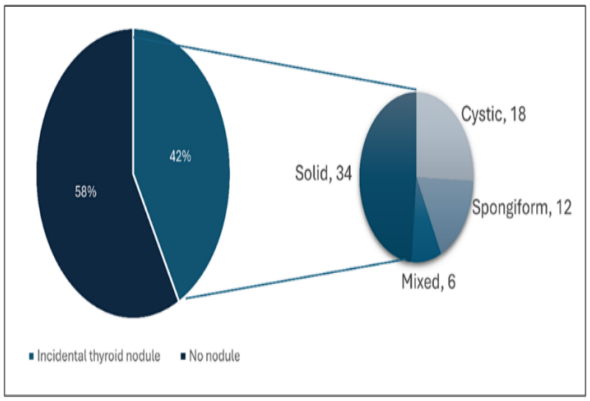

Figure 1: Prevalence and composition of incidental thyroid nodules in renal transplant recipients.

The detected nodules ranged from 4-35 mm in maximum dimension (mean: 11.85 ± 6.3 mm), with 27 (38.6%) being less than 10 mm. Based on the TIRADS classification, 16 nodules (9.6%) were categorized as mildly suspicious (TIRADS 3), 19 (11.4%) as moderately suspicious (TIRADS 4), and 3 nodules (1.8%) were classified as highly suspicious (TIRADS 5). Seven (10%) proved to be malignant by cyto / histopathology. According to histopathology results, malignancy was confirmed in 7 cases. Among various demographic variables, RT patient characteristics, and US features, TIRADS classification demonstrated a statistically significant association with malignancy (Table 2). In terms of TIRADS categorization, 57.1% of malignant nodules were classified as TIRADS 4 and 42.9% as TIRADS 5. In contrast, benign nodules comprised 23.8% TIRADS 4, 25.4% TIRADS 2, and 24.9% of TIRADS 1 lesions ($p< 0.001$). Patients with malignant nodules exhibited a lower BMI (24.8 ± 2.0 kg/m²) compared to those with benign nodules (27.9 ± 5.6 kg/m², $p= 0.060$). The features of incidental thyroid nodules in RT recipients were compared to those in an age- and sex-matched healthy control group (Table 3).

Table 2: Demographic characteristics and thyroid nodule features of Renal transplant group, which underwent FNA or surgical excision (n=70)

Variables		Total Number	Benign (n=63)	Malignant (n=7)	*p*-value
Age (year) mean±SD (range)		70	46.4±9.6(24-65)	54.7±11.7(35-70)	0.076
Sex n(%)	Female	19	17(27)	2(28.6)	1.0
	Male	51	46(73)	5(71.4)	
BMI kg/m² mean±SD (range)		70	27.9±5.6(14.1-41.02)	24.8±2(23.1-28.7)	0.060
Duration since RT (year)	Median	70	4.56 (0-19)	7.7 (1-18)	0.611
	<6	43	39(61.9)	4(57.1)	1.000
	≥ 6	27	24(38.1)	3(42.9)	
Time of HD/PD up to transplant (month) median(range)		70	3(0-60)	5(5-12)	0.527
Cause of transplantation n(%)	hypertension	21	17(27)	4(57.1)	
	Unknown	17	16(25.4)	1(14.3)	
	Gestational hypertension	2	2(3.2)	0(0.0)	
	Diabetes mellitus	14	14(22.2)	0(0.0)	
	Bilharziasis	2	0(0.0)	2(28.6)	0.069
	Nephrotic syndrome	6	6(9.5)	0(0.0)	
	NSAID	2	2(3.2)	0(0.0)	
	IgA NP	2	2(3.2)	0(0.0)	
	HV shock	2	2(3.2)	0(0.0)	
	ADPKD	2	2(3.2)	0(0.0)	
Type of immune suppression	Prednisolone	66	159(93.7)	7(100)	1.0
	Tacrolimus	58	51(81)	7(100)	0.343
	Mycophenolic acid	27	24(38.1)	3(42.9)	1.0
	Cyclosporine	41	37(58.7)	4(57.1)	1.0
Thyroid size	Normal	58	54(85.7)	4(57.1)	0.092
	Enlarged	12	9(14.3)	3(42.9)	
Number of nodules	Single	16	12(75)	4(57.1)	0.63
	Multiple	7	4(25)	3(42.9)	
Size of the nodules (mm) mean±SD (range)		23	10.71±5.37(5-20)	14.33±3.33(10-20)	0.080
TI-RADS n(%)	1	22	22(34.9)	0(0.0)	
	2	10	10(15.9)	0(0.0)	<0.000
	3	16	16(25.4)	0(0.0)	1
	4	19	15(93.8)	4(57.1)	
	5	3	0(0.0)	3(42.9)	

Table 3: Demographics and thyroid features of study groups

Variable		Total number	RT group (n=70)	Control group (n=69)	*p*-value
Age (year) mean±SD (range)			42±12 (19-70)	41±15 (17-84)	0.597
Sex n(%)	Female	105	37(22.3)	68(30.8)	0.063
	Male	282	129(77.7)	153(69.2)	
Thyroid size n(%)	Normal	349	154(92.8)	195(88.2)	0.28
	Shrunken	2	0(0.0)	2(0.9)	
	Enlarged	36	12(7.2)	24(10.9)	
Pathology n(%)	Single	75	36(51.4)	39(52.7)	0.087
	Multiple	64	34(48.6)	31(40.5)	
	Thyroiditis	5	0(0.0)	5(6.8)	
Nodule size mean±SD (range)			11.85±6.3 (4-35)	11.81±7.7 (2-35)	0.387
Nodule composition n(%)	Cystic	28	18(25.7)	10(14.5)	
	Spongiform	19	12(17.15)	7(10.1)	0.158
	Mixed	15	6(8.6)	9(13)	
	Solid	77	34(48.6)	43(62.3)	
TI-RADS n(%)	1	250	118(71.1)	132(70.6)	0.387
	2	23	10(6)	13(7)	
	3	33	16(9.6)	19(10.2)	
	4	33	19(11.4)	14(7.5)	
	5	12	3(1.8)	9(4.8)	
Histopathology n(%)	Benign	125	63(90)	62(89.9)	1.0
	Malignant	14	7(10)	7(10.1	

The overall prevalence in the control group was 69 (31.2%), which is relatively lower than in the RT group, 70 (42.2%); however, the characteristics of the nodules were comparable. In the RT cohort, 36 individuals (51.4%) exhibited a solitary nodule, while 34 (48.6%) had multiple nodules. Similarly, in the control group, 39 cases (52.7%) presented with single nodules and 31 (40.5%) with multiple nodules, with an additional 5 cases demonstrating sonographic features suggestive of thyroiditis (p= 0.087). Moreover, the pattern of nodule classification according to TI-RADS criteria showed no significant variation between renal transplant recipients and controls (Figure 2). Importantly, the malignancy rate among incidentally identified nodules in RT recipients was 10%, which did not significantly differ from that observed in healthy controls (p= 1.0). All malignant lesions in RT were papillary thyroid carcinoma (PTC), whereas two cases (2.9%) in the control group were follicular carcinoma.

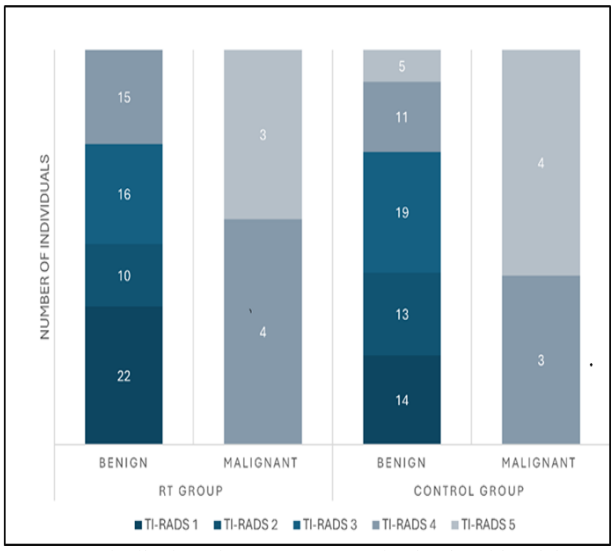

Figure 2: Distribution of TI-RADS categories for thyroid nodules in both study groups.

DISCUSSION

This report will be the first systematic review of the prevalence of thyroid nodules in RT patients, and an incidental nodule of the thyroid will have a very high incidence on ultrasound (42.2%). Out of these nodules, 10 percent of them showed malignant histopathological characteristics. Although the result is a high prevalence and malignancy rate, statistical comparison with an age- and sex-matched healthy control group revealed that there was no significant difference. These results are resistant to the current supposition that immunosuppression among RT patients is a significant risk factor of thyroid cancer. The prevalence of thyroid nodules detected in the RT group was benign and was mostly in the form of simple cysts or TIRADS 2 lesions, which were in the control group. It is worth noting that 38.6 percent of these nodules were smaller than 10 mm. Comparatively, a lower rate of functional or morphological thyroid changes, 204 cases (26.8%), was observed in the study by Veroux *et al*., which retrospectively assessed thyroid nodules in end-stage renal disease (ESRD) patients before renal transplantation, with around 80% of the nodules being less than 10 mm [2]. We found a similar prevalence of suspicious thyroid nodules in RT recipients and healthy controls. Moderately suspicious nodules (TI-RADS 4) were found to comprise 11.4% of the RTs, and highly suspicious nodules (TI-RADS 5) were 1.8%. These frequencies were similar to those observed in the healthy control group, which showed rates of 7.5% for TI-RADS 4 nodules and 4.8% for TI-RADS 5 nodules (p= 0.24 for TI-RADS 4 comparison; p= 0.18 for TI-RADS 5 comparison). This group is associated with a notable malignancy risk among biopsied nodules, with 10% of sampled nodules demonstrating malignant pathology. The findings align with previous research by Yalcin *et al*. (2016), who retrospectively evaluated 287 patients with non-thyroid malignancies and incidentally detected thyroid nodules, reporting a comparable malignancy rate of 11.1% [10]. On the other hand, the malignancy rate in the RT cohort of the Veroux et al. study demonstrated an 8.8% malignancy rate among detected thyroid nodules, with a strong male predominance (83% of malignant cases) and prolonged post-transplant latency (mean 5.6 years; range 3–12 years) to malignancy diagnosis [2]. A meta-analysis of 50,861 RT patients with long-term follow-up reported a 6.9-fold higher standardized incidence ratio of malignancy compared with non-transplant populations, with a median time to diagnosis of six years post-transplantation [12]. In contrast, more than half of the malignant cases identified in the present study occurred within the first six years after transplantation. This observation underscores the need to have early surveillance mechanisms to help in early detection and management because late diagnosis can have negative impacts. Notably, the meta-analysis reported poorer survival among transplant recipients who developed malignancy, with an increased risk of death (HR= 1.33, 95%CI: 1.02–1.73) [12]. All malignant cases in our cohort were papillary thyroid carcinoma (PTC), consistent with previous reports. Kitahara *et al*. demonstrated that thyroid cancer was more frequently observed in kidney recipients compared with other solid organ transplant recipients (IRR= 1.26, 95%CI: 1.03–1.53) [13]. They further identified prolonged dialysis prior to transplantation and RT due to hypertensive nephrosclerosis as risk factors for thyroid cancer development. In our cohort, thyroid cancer patients had longer dialysis duration before transplantation (median 5 years, range 5–12), although the difference did not reach statistical significance. Additionally, more than half of these patients had hypertensive nephrosclerosis as the underlying cause of renal failure, but this association showed only marginal significance (p= 0.06). A meta-analysis of 50861 RT patients with long-term follow-up identified a 6.9-fold higher standardized incidence ratio as compared with a non-transplant with a median time to discovery of 6 years post-transplantation [12]. However, more than half of the malignant cases diagnosed in the current study occurred in the first 6 years post-transplantation. We found that all the malignant cases in the present study were PTC, consistent with other studies. Kitahara *et al*. recognized thyroid cancer was more encountered in kidney recipients compared to other organ transplants (IRR= 1.26, 95%CI: 1.03–1.53) [13]. They identified prolonged dialysis before transplant and RT due to hypertension and nephrosclerosis as risk factors for thyroid cancer development. In our RT cohort, thyroid cancer patients had longer dialysis time before the transplant (5-12 months) yet did not reach statistical significance. More than half of them had hypertensive nephrosclerosis, but with marginal significance p= 0.06. The current study identified different demographic and clinical trends among RT patients with malignant thyroid nodules, though none reached statistical significance. RT patients with malignant nodules tended to be older (54.7 ± 11.7 years) compared to those with benign nodules (46.4 ± 9.6 years) and had lower BMI values (24.8 ± 2 kg/m² versus 27.9 ± 5.6 kg/m²). While males represented 71.4% of malignant cases, this figure likely reflects

the overall male predominance in the RT cohort rather than a true gender association with malignancy risk. Neither time since transplantation nor specific immunosuppressant regimens emerged as significant predictors of nodule malignancy. The sole statistically significant factor was the TI-RADS classification score ($p< 0.001$), suggesting that post-transplant immunosuppression may not substantially accelerate malignant transformation in thyroid nodules, and conventional TI-RADS criteria maintain their diagnostic validity in the RT population. These findings support the use of standard ultrasound risk stratification systems for this patient group, while highlighting the need for further investigation into potentially modifiable risk factors.

Study Limitations

As a single-center study, the results may not be globally generalizable due to potential differences in patient demographics, clinical practices, and imaging protocols.

Conclusion

Prevalence and the rate of malignancy of incidental thyroid nodules among renal transplant patients are similar to those of the general population. The findings indicate that the long-term immunosuppressive therapy has no significant impact on nodule development and malignant progression. Considering the fairly high prevalence and significant malignancy rate, regular surveillance can be the option, but further study is justified to implement the best monitoring measures. We recommend annual thyroid ultrasound screening to facilitate early detection while avoiding overdiagnosis and to strictly adhere to ACR TI-RADS criteria to ensure appropriate intervention for moderate/high-risk nodules and prevent unnecessary biopsies of low-risk nodules.

List of abbreviations

TIRADS: Thyroid Imaging Reporting and Data System; ESRD: end-stage renal disease; TSH: thyroid-stimulating hormone; BMI: Body mass index; FNA: Fine-needle aspiration; RT: renal transplant; NSAID: non-steroidal anti-inflammatory drugs; HD: hemodialysis; PD: peritoneal dialysis; NP: nephropathy.

Conflict of interests

The authors declared no conflict of interest.

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Data sharing statement

The data that supports the findings of this study are available from the corresponding author upon a reasonable request.

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