RESEARCH ARTICLE

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Long-Term Survival Rate for Moroccan Patients with Differentiated Thyroid Cancer

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Abstract

Background: The prognosis for differentiated thyroid cancer of follicular origin (DTC) is generally good, with survival rates comparable to those of the general population for some patients. However, overall survival is influenced by many factors. Our study aims to analyze five-year and ten-year overall survival rates in follicular differentiated thyroid cancer and the independent factors influencing it in Moroccan patients. **Methods:** This retrospective cohort study included all patients with differentiated thyroid cancer referred to the nuclear medicine department at Ibn Rochd Hospital between 2004 and 2012. Using the Kaplan-Meier method, we calculated overall survival, five-year survival, and ten-year survival rates. We compared overall survival according to several factors using the log-rank test. **Results:** A total of 1366 patients were included in the study, distributed as follows: 89.6% were female, and 10.4% were male, with a sex ratio of 8.5. The mean age at diagnosis was 44 years, with extremes ranging from 14 to 85 years. The mean overall survival was 26.074 years [25.51; 26.63 years]. The five-year survival rate was 94%, and the ten-year survival rate was 91%. Male gender, age over 55 years, follicular histological type, tumor size >4 cm, ETE and vascular invasion, postoperative Tg level and post-RAI therapy >10 ng/ml, presence of lymph node invasion, and distant metastases are factors that reduce survival rates in patients with DTC. Additionally, advanced-stage and high-risk groups are associated with lower overall survival rates ($p < 0.001$). **Conclusion:** Overall survival rates in Moroccan patients with DTC are equivalent to those described in the literature. It is also significantly influenced by age, gender, histological type, vascular invasion, extra-thyroidal extension, postoperative Tg level, post-RAI therapy, the presence of lymph node invasion and distant metastases, as well as disease stage and risk group, as widely reported in the literature.

Keywords: Overall survival- DTC- Thyroid carcinoma- Moroccan patients- long term survival rates

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Introduction

The incidence of thyroid cancer (TC) in Casablanca is increasing every year. The latest version of the Casablanca Cancer Registry (2012–2017) reported that the worldwide population-standardized incidence of thyroid cancer is 8.4/100,000. It is now the second most frequent malignant tumor in women after breast cancer in Morocco [1]. This increase in incidence is not confined to Morocco and has been widely reported in the literature [2]. Nevertheless, differentiated thyroid cancer of follicular origin generally has a good prognosis, with a ten-year survival rate of over 90% [3]. It comprises mainly three subtypes, according to the World Health Organization (WHO, 2017): papillary thyroid carcinoma (PTC), follicular thyroid carcinoma (FTC), and Hurthle cell carcinoma (HCC) [4]. More than 90% of DTCs registered between 2013 and 2017 in the Greater Casablanca region were stage I, according to the 8th edition of the American Joint Committee on Cancer (AJCC) staging system for thyroid cancer, with a predominance of PTC (82%) [1].

The management of DTC is based on surgery, followed by internal radiotherapy vectored with iodine-131 (RAI) and hormone replacement therapy [5]. Response to treatment depends on several factors, such as patient age, gender, histological types of DTC, extrathyroidal extension, vascular invasion, lymph node involvement (N+), and metastatic (M+) extension status [6, 7].

The analysis of survival in DTC, as in any other type of cancer, represents an important line of research. This analysis has been explored by numerous researchers in different parts of the world and has shown that overall survival in DTC is comparable to that of the general population. However, it varies from patient to patient. Some attribute this heterogeneity to ethnic origin [8], while others link differences in overall survival to

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clinicopathological parameters [6, 9, 10].

Despite the global attention to survival analysis in differentiated thyroid cancer, there remains a significant gap in the Moroccan context, where no studies have comprehensively analyzed overall survival in DTC. The absence of such research limits our understanding of the outcomes specific to Moroccan patients, given potential regional and demographic variations in clinicopathological characteristics. Conducting this analysis in Morocco is critical to establishing a baseline understanding of overall survival rates and identifying factors influencing these outcomes within this unique population.

Thus, in this context, this study aims to calculate overall survival (OS) in Moroccan patients through a sample of 1366 DTC patients followed at the nuclear medicine department of the IBN ROCHD hospital in Casablanca. This analysis will also examine the variation in overall survival according to several parameters, such as age, gender, histological type, histopathological features, thyroglobulin level postoperatively and after RAI therapy, and the patient's N and M status at the time of diagnosis.

Materials and Methods

This retrospective cohort study included all patients with differentiated thyroid cancer referred to the nuclear medicine department at Ibn Rochd Hospital between 2004 and 2012. The data collection was completed in 2022. Active surveillance was conducted via telephone calls to determine patients' vital status. For survival analysis, the start date was defined as the date of histological confirmation, while the end date was either the date of the last telephone call or the date of death.

Patients were followed up for a minimum of 10 years, ensuring robust long-term survival data. For patients diagnosed prior to 2004 but referred to the center during the study period, we retrieved their medical information from the diagnostic structure where the initial diagnosis was made, including cases with initial diagnoses dating back as early as 1992. Survival for these cases was calculated from the date of initial diagnosis.

Initial descriptive analyses were performed to calculate overall survival using the Kaplan-Meier method. Survival rates were compared using the log-rank test, considering variables such as sociodemographic characteristics (age, gender) and clinicopathological features (histological type, tumor stage, recurrence risk based on the 2015 ATA guidelines). A p-value of <0.05 was considered statistically significant. Statistical analysis was performed using JAMOVI software version 2.3.17.

Patients were categorized by age (<55 years and ≥55 years), gender, histological type, AJCC 8th edition stage, and recurrence risk groups (low, intermediate, high) as per ATA 2015 guidelines. These categories were used to stratify survival analyses and evaluate trends over time.

The Ethics Committees for Biomedical Research of Casablanca and CHU Ibn Rochd approved the study (decree numbers 02/2022 and 14/22, respectively). Informed consent was obtained from all patients after a detailed explanation of the study's objectives and procedures.

Results

Our study population of 1366 patients were distributed as follows: 89.6% were female and 10.4% were male, with a sex ratio of 8.5. The mean age at diagnosis was 44 years, with extremes ranging from 14 to 85 years. Patients aged under 55 accounted for 79%, and those aged 55 and over accounted for 21%. All our patients underwent a total thyroidectomy. PTC was the predominant histological type (93%), followed by follicular thyroid carcinoma in 6.41% and Hurthle cell carcinoma in 0.40% (5 patients). Tumors larger than 4 cm were present in 13.60% of cases. The tumor was unifocal in 71.3% of cases, bifocal in 15.2%, and multifocal in 13.5%. Vascular invasion (emboli) was present in 6% of cases. Seven patients (9%) had information on the nature of this invasion, which was minimal in 6% of cases. The extra-thyroidal extension was present in 5.38% of cases. The mean postoperative thyroglobulin level was 131 ng/ml, with extremes ranging from 0.01 to 81,007 ng/ml. We classified our patients into three categories according to TG levels postoperatively and after treatment with RAI therapy: undetectable (<1 ng/ml), detectable (>1 ng/ml and ≤10 ng/ml without morphological lesions), and >10 ng/ml with or without morphological lesions. For initial postoperative Tg levels, 13% of patients had undetectable Tg levels, 56% had detectable Tg (>1 ng/ml and ≤10 ng/ml), and 31% had Tg >10 ng/ml. RAI therapy was performed in 87% of patients. Of these, 94.64% received a single course of treatment, 3.82% received two courses, and 1.10%, 0.25%, and 0.17% received three, four, and five courses, respectively. The mean iodine activity received was 3.996 GBq, with extremes ranging from 3.7 GBq to 27.75 GBq. The mean time between total thyroidectomy and the first dose of RAI therapy was 18 months, ranging from 30 days to 37 months. For Tg levels after RAI therapy, 82% had undetectable Tg, 13% had detectable Tg (>1 ng/ml and ≤10 ng/ml), and 5% had Tg >10 ng/ml.

At the time of diagnosis, extension to the cervical lymph nodes and distant metastases were present in 2.58% and 0.65%, respectively. Five patients had bone metastases, two had brain metastases, and two had lung metastases. According to the 8th edition of the AJCC, 94.13% of patients were classified as stage I, 4.59% as stage II, 0.68% as stage III, and 0.6% as stage IV. According to the ATA risk groups classification, 83% were classified as low risk, 9% as intermediate risk, and 8% as high risk (Table 1).

The average overall survival was 26.074 years [25.51; 26.63]. At the end of the study, 67.34% of the patients were still living, while 24.17 were lost during follow-up and 8.49% (116 patients) died. Of these 116 deaths, 72 (5.27%) were related to thyroid cancer. Bone and lung metastases were shown to be the leading causes of death, accounting for 31% and 25%, respectively. Notably, eighteen patients died due to the COVID-19 infection (Figure 1).

Five years Survival

The five-year survival rate was 94%. Five-year survival rates showed significant differences based on gender and

Table 1. Characteristics of the Population (n =1366)

Variable	Frequency	Percentage %
Age		
<55 years	1,079	79.0
≥55 years	287	21.0
Gender		
Male	1,223	10.4
Female	143	89.6
Histological type		
PTC	1,273	93.2
FTC	88	6.4
HCC	5	0.4
Tumor size		
≤4 cm	1,180	86.4
>4 cm	186	13.6
Multifocality		
Unifocal	978	71.3
Bifocal	204	15.2
Multifocal	184	13.5
Nodular invasion		
Yes	193	14.2
No	1173	85.8
Extra thyroidal extension		
Yes	73	5.4
No	1293	94.6
Vascular invasion		
Yes	85	6.2
No	1,281	93.8
Postoperative Tg levels		
Undetectable	178	13.0
Detectable (>1 ng/m and≤10 ng/ml)	765	56.0
>10 ng/ml	423	31.0
Cervical nodes at diagnosis		
Yes	36	2.6
No	1330	97.4
Distant metastasis at diagnosis		
Yes	9	0.6
No	1,357	99.4
Stage		
I	1,285	94.1
II	63	4.6
III	8	0.7
IV	9	0.6
Risk groups		
Low Risk	1,134	83.0
Intermediate risk	123	9.0
High risk	109	8.0
RAI ablation		
Yes	1,188	87.0
No	178	13.0
Tg levels after RAI ablation		
Undetectable	974	82.0
Detectable (>1 ng/m and≤10 ng/ml)	154	13.0
>10 ng/ml	60	5.0

age. The five-year rate was 95% in female patients and 82% in male patients (p <0.001). The five-year survival rate was 98% in patients aged under 55 versus 78% in patients aged 55 and over (p <0.001) (Table 2) (Figure 2).

Significant disparities were also revealed in the log-rank test (p <0.001) concerning histological type. Patients with papillary thyroid carcinoma had a five-year survival rate of 95% versus 85% for those with follicular thyroid carcinoma. All five patients (100%) with Hürthle cell carcinoma survived until the study's end (Figure 3).

Five-year survival also showed statistically significant differences according to tumor size (p <0.001). The five-year rate was 95.9% in patients with tumors smaller than 4 cm versus 90.9% in patients with tumors larger than 4 cm.

Regarding histopathological features, patients with multifocal tumors had a five-year survival rate of 93%, compared to 94% and 96% in those with unifocal and bifocal tumors, respectively. However, this difference did not reach statistical significance (p = 0.434) (Table 2).

Furthermore, our results showed that extrathyroidal extension had a significant impact on survival rates. Patients with tumors characterized by extrathyroidal extension had five-year survival rates of 75%, compared to 95% in those without ETE (p <0.001). This trend was also observed for vascular invasion, with the five-year survival rate in patients without vascular invasion being 95%, compared to 84% in those with it (Table 2).

Our results also revealed that patients with postoperative Tg levels >10 ng/ml had a five-year survival rate of 88%, compared to 97% and 96% in those with detectable (<10 ng/ml) and undetectable Tg levels, respectively (p = 0.010) (Table 2). The five-year survival of patients with N+ status at diagnosis was 86%, compared to 94% for patients with no lymph node involvement (p <0.001). Patients with M+ at diagnosis did not reach five years. The Kaplan-Meier curves for these different groups are summarized in Figure 2. Tg levels after RAI therapy were associated with a significant difference in five-year survival (p < 0.001). The five-year survival rates were 97% in patients with undetectable Tg, 93% in patients with detectable Tg (>1 ng/ml and ≤10 ng/ml), and 80% in patients with Tg >10 ng/ml (Table 2).

We studied the influence of disease stage and risk groups on survival rates. The five-year survival rate for patients classified as stage I was 97%, versus 66% for stage II patients and 35% for stage III patients. Stage IV patients did not achieve five-year survival (p < 0.001). In terms of patient classification according to the risk of recurrence, low-risk patients had a five-year survival rate of 97%, intermediate-risk patients had a five-year survival

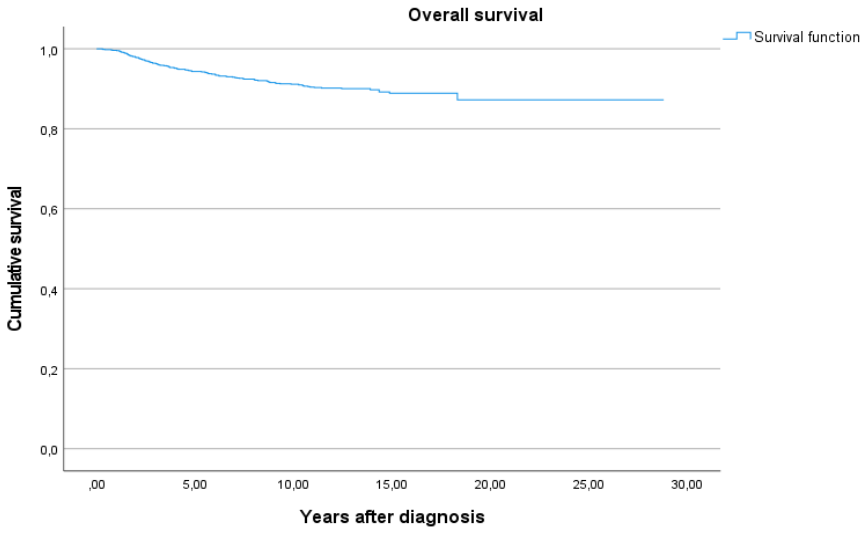

Figure 1. Kaplan Meier Survival Curve

rate of 85%, and those classified as high-risk had a five-year survival rate of 72%. This difference was statistically significant ($p < 0.001$) (Table 2 and Figure 2).

Ten-year Survival

The ten-year overall survival rate was 91%. Log-rank test results reveal significant variations in ten-year survival

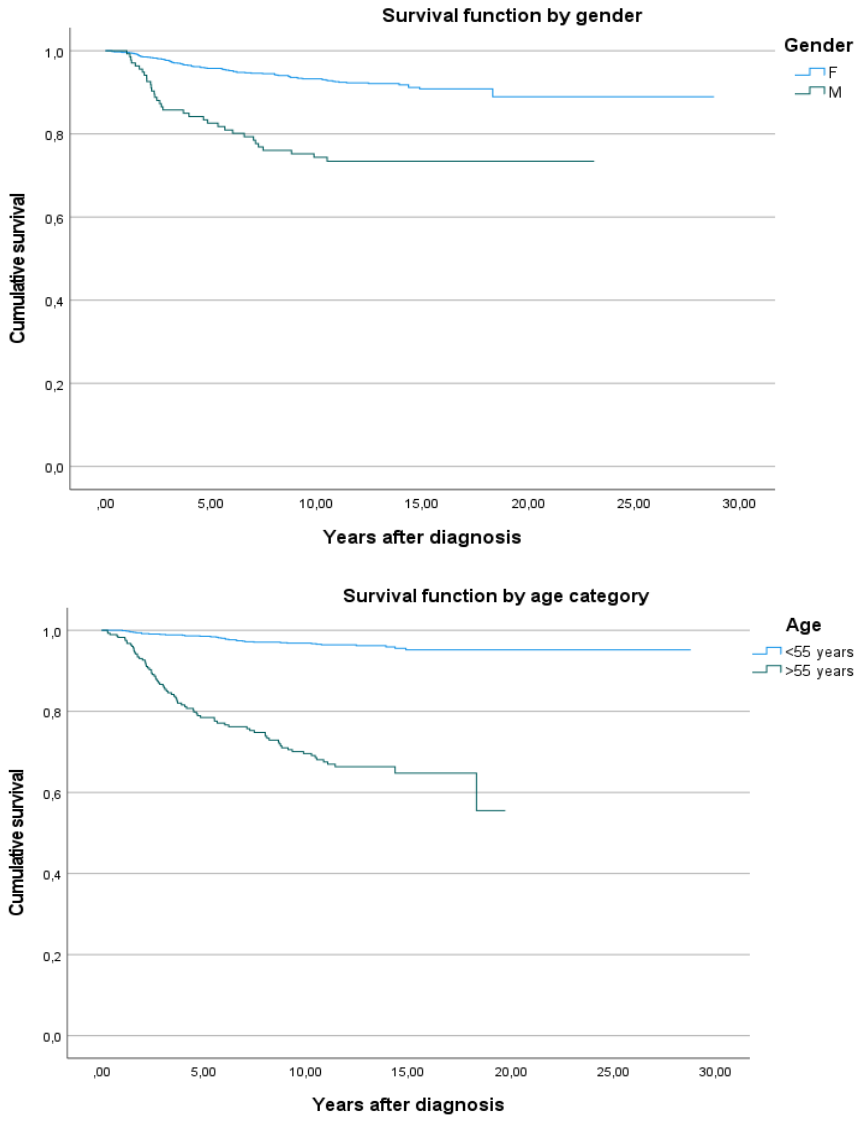

Figure 2. Kaplan Meier Survival Curves According to Sociodemographic Characteristic's

Table 2. Log-Rank Test Results for Five-Year Survival

	% five-year rate of survival	P value
Gender		<0.001
Male	82.0	
Female	95.0	
Age		<0.001
<55 years	98.0	
≥55 years	78.0	
Histological type		<0.001
PTC	94.0	
FTC	85.0	
HCC	100.0	
Tumor size		<0.001
<4 cm	95.9	
>4 cm	90.9	
Multifocality		0.434
Unifocal	94.0	
Bifocal	96.0	
Multifocal	93.0	
Extrathyroidal extension		<0.001
Yes	75.0	
No	95.0	
Vascular invasion		<0.001
Yes	84.0	
No	95.0	
Node involvement		0.010
Yes	86.0	
No	94.0	
Tg postoperative levels		<0.001
Undetectable	96.0	
Detectable	97.0	
>10	88.0	
Metastasis at Diagnosis		<0.001
Yes	-	
No	95.0	
Stage		<0.001
I	97.0	
II	66.0	
III	37.0	
IV	-	
ATA Risk groups		<0.001
Low risk	97.0	
Intermediate risk	86.0	
High risk	72.0	
Tg levels after Radioiodine		<0.001
Undetectable	97.0	
Detectable (>1 ng/m and≤10 ng/ml)	93.0	
>10 ng/ml	80.0	

Table 3. Log Rank Results: Ten years' Survival

	% ten-year rate of survival	P value
Gender		<.001
Male	74.0	
Female	93.0	
Age		<.001
<55 years	96.0	
≥55 years	69.0	
Histological type		<.001
PTC	92.0	
FTC	76.0	
HCC	100.0	
Tumor size		<.001
<4 cm	93.5	
>4 cm	85.7	
Multifocality		0.434
Unifocal	91.0	
Bifocal	93.0	
Multifocal	88.0	
Extrathyroidal extension		<0.001
Yes	61.0	
No	93.0	
Vascular invasion		<.001
Yes	75.0	
No	92.0	
Node involvement		0.010
Yes	79.0	
No	91.0	
Tg postoperative		<0.001
Undetectable	94.0	
Detectable	94.0	
>10	83.0	
Metastasis at Diagnosis		<0.001
Yes	-	
No	91.0	
Stage		<0.001
I	94.0	
II	55.0	
III	-	
IV	-	
ATA Risk groups		<0.001
Low risk	95.0	
Intermediate risk	80.0	
High risk	59.0	
Tg levels after Radioiodine		<0.001
Undetectable	95.0	
Detectable (>1 ng/m and≤10 ng/ml)	91.0	
>10 ng/ml	59.0	

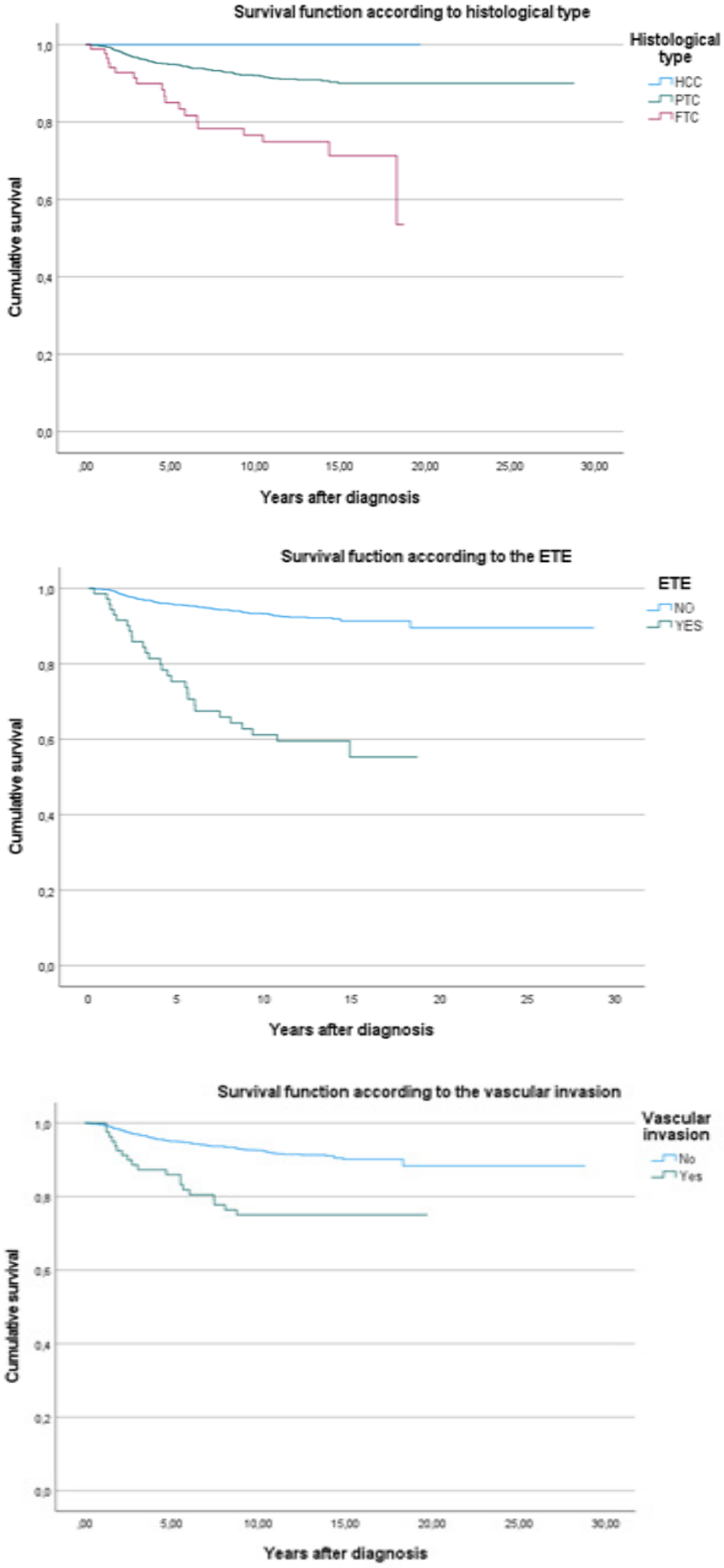

Figure 3. Kaplan Meier Survival Curve According to Histopathological Characteristics

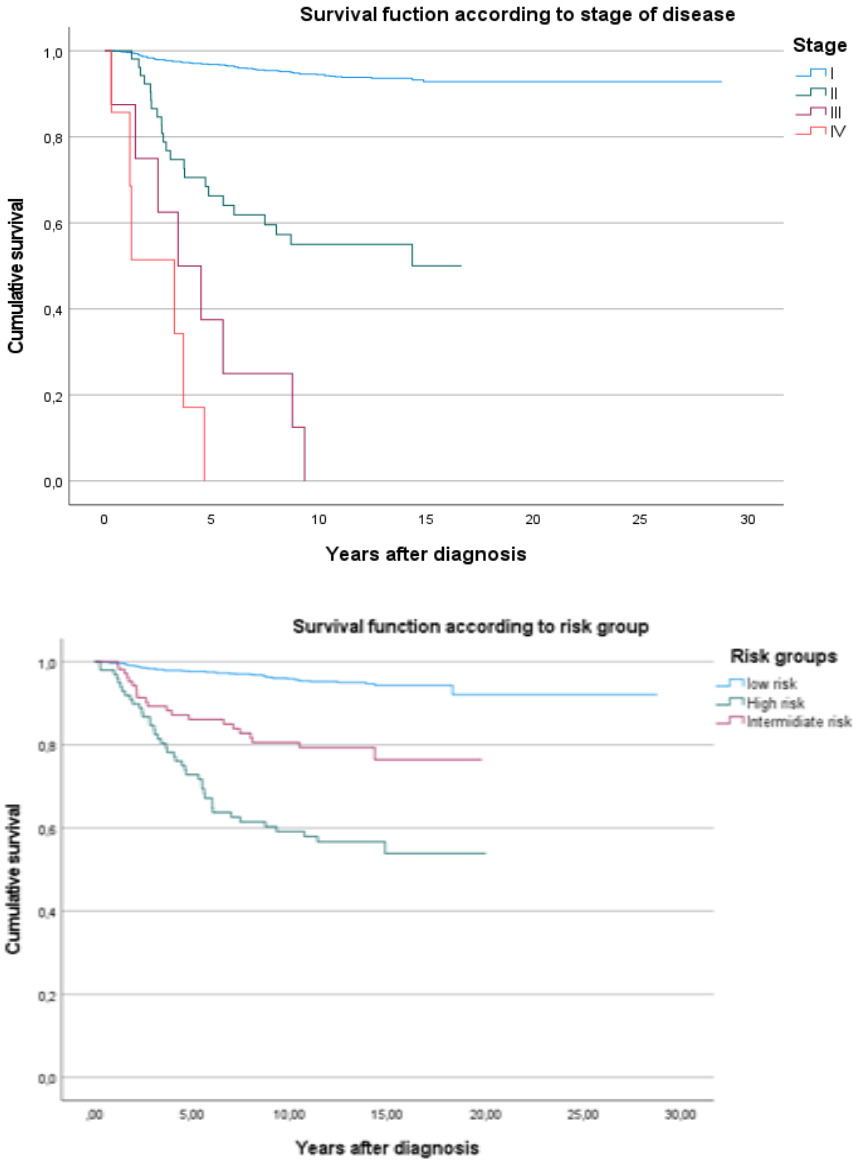

Figure 4. Kaplan Meier Survival Curves According the Stage of Disease and Risks Groups (ATA, 2015)

between females and males and age groups. The ten-year survival rate for females was 93%, versus 74% for males ($p < 0.001$). Regarding age, patients under 55 years of age had a 96% survival rate, while those aged 55 and over had a 69% survival rate ($p < 0.001$) (Table 3).

The ten-year survival rates were 92% for PTC, 76% for FTC, and 100% for HCC ($p < 0.001$). Patients with tumors smaller than or equal to 4 cm had a ten-year survival rate of 93.5%, compared with 85.7% for patients with tumors larger than 4 cm ($p < 0.001$). Patients without extrathyroidal extension had a ten-year survival rate of 93%, versus 61% in those with extension ($p < 0.001$). Survival rates were 92% for patients without vascular invasion and 75% for those with vascular invasion ($p < 0.001$) (Table 3).

Patients without lymph node involvement had a ten-year survival rate of 91%, while those with lymph node involvement had a ten-year survival rate of 79% ($p = 0.010$). Concerning postoperative Tg levels, ten-year survival rates were 94% for patients with undetectable Tg, 94% for those with detectable Tg (>1 ng/ml and ≤10 ng/ml), and 83% for those with Tg >10 ng/ml ($p < 0.001$) (Table 3).

Survival rates at ten years were 94% for stage I and 55% for stage II ($p < 0.001$). The ten-year survival rates were 95% for low-risk patients, 80% for intermediate-risk patients, and 59% for high-risk patients ($p < 0.001$). Patients with undetectable Tg after treatment with RAI therapy had a 95% ten-year survival rate; those with detectable Tg (between 1 and 10 ng/ml) had a 91% ten-year survival rate; and those with Tg >10 ng/ml had a 59% ten-year survival rate ($p < 0.001$). However, the difference in survival rates according to tumor foci was statistically insignificant ($p = 0.434$). The ten-year survival rate was 91% for patients with unifocal tumors, 93% for patients with bifocal tumors, and 88% for patients with multifocal tumors (Table 3)(Figure 4).

Discussion

This large cohort study aims to identify overall survival and its independent factors in Moroccan patients affected

by differentiated thyroid cancers of follicular origin (DTC). The mean overall survival was 26.074 years (CI [25.51; 26.63 years]). At the end of the study, 67.34% of patients were still alive; their five- and ten-year survival rates were 94% and 91%, respectively. These results concur with the observations of Echihron et al., who revealed five- and ten-year survival rates of 95% and 90%, respectively, in a population-based study of 484 patients with DTC [11]. They are also consistent with the results of Triponez et al., who reported five- and ten-year survival rates of 88% and 85%, respectively [12]. A mortality rate of 8.49% (116 patients) was noted at the end of the study, of which 72 (5.27%) were attributable to thyroid cancer. Bone and lung metastases were identified as the main causes of mortality, with respective rates of 31% and 25%. The DTC-related death rate is higher than that reported by a study based on 61,523 patients in the United States, which reported a thyroid-related death rate of 2.88% [13]. This discrepancy can be explained by the fact that the sample size enabled a higher death rate to be identified; a smaller sample size can make the results more sensitive to statistical variations and anomalies, and the different characteristics of the two study populations can influence the results.

The prognosis of DTC is adversely affected by age. Many researchers agree that advanced age is associated with reduced life expectancy and increased mortality rates. A less optimistic outlook emerges for individuals diagnosed after the age of 40 [14, 15]. Moreover, age is invariably considered a preeminent risk factor in most risk stratification systems, such as TNM-AJCC. In the same vein, the work of Mazurat et al. [16] in a study of a sample of 2115 patients, highlighted age over 55 as an independent risk factor exerting an unfavorable impact on survival in the context of DTC [16]. These observations are consistent with those of our study. Our analysis highlighted a statistically significant disparity in five- and ten-year survival rates between patients aged under 55 and those over 55. Patients under 55 had higher survival rates than those over 55: 98% versus 78% at five years and 96% versus 69% at ten years ($p < 0.001$).

Gender also emerges as an independent factor significantly impacting overall survival. An analysis of survival rates at five and ten years reveals that men have lower survival rates than women: 82% versus 95% at five years and 73% versus 94% at ten years ($p < 0.001$). This disparity is echoed in several studies dedicated to survival in the context of DTC. A study by Dal Maso et al. on 86,690 patients reported a five-year survival rate of 96% in women versus 93% in men, revealing that age and gender represent very important prognostic factors [17]. Research by Eichhorn et al. [11] Haigh et al. [18] and Jonklaas et al. [19] confirms this trend, showing that women have less aggressive forms of DTC than men. The latter, due to more aggressive histological variants of DTC and a higher average age, have less favorable survival rates [11, 18, 19].

The results of the log-rank test showed significant associations between the different histopathological features of the DTCs and the overall survival rates. Patients with papillary thyroid carcinoma had five-year survival rates of 94% and ten-year survival rates of 92%, while those with follicular thyroid carcinoma had lower survival rates, 85% at five years and 76% at ten years. Hürthle cell carcinoma patients stood out with high survival rates, reaching 100% at both five and ten years. This is explained by the low number of patients (5 patients). These results are consistent with those reported in the literature; indeed, many studies of DTCs acknowledge the impact of histological features on patient survival. They suggest that papillary thyroid carcinoma has an excellent prognosis compared with other types. Multivariate analysis by Gulcelik et al. [20] showed that follicular histological type was associated with a worse prognosis in terms of overall survival and recurrence-free survival compared with papillary thyroid cancer. They reported a ten-year survival rate of 81% in patients with follicular type versus 91% for those with papillary type [20]. The same results were reported by H.Joensu et al. in their study, where they observed similar survival trends between these two histological types, with papillary carcinoma patients having a more favorable survival rate than follicular carcinoma patients ($p = 0.008$) [21].

The difference in survival at five and ten years was also statistically significant according to tumor size ($p < 0.001$). Patients with tumors measuring less than 4 cm had five- and ten-year survival rates of 95.9% and 93.5%, respectively, compared with 90.9% and 85.7% for those with tumors measuring more than 4 cm. Xuan V et al., in a study of 112,128 patients, also showed that tumor size influences survival in DTCs: the larger the tumor size, the poorer the survival [22].

Extrathyroid extension is strongly associated with decreased survival rates, with 75% at five years and 61% at ten years for cases where it is present, compared with 95% at five years and 93% at ten years for cases where it is absent ($p < 0.001$). Similarly, vascular invasion is a crucial histopronostic factor, with lower survival rates in patients with tumors with vascular invasion (84% at five years and 75% at ten years) compared with those without vascular invasion (95% at five years and 92% at ten years, $p < 0.001$). Regarding the number of tumor foci, patients with multifocal tumors had slightly lower survival rates than those with unifocal and bifocal tumors. The five-year survival rates were 93% for multifocal tumors, 96% for bifocal tumors, and 94% for unifocal tumors. Survival at ten years was 88% in multifocal tumors versus 93% in bifocal tumors and 91% in unifocal tumors. However, this difference was not statistically significant ($p = 0.434$). These results were similar to those found in the literature, where several studies have stated that the presence of multifocality, extrathyroidal extension, and vascular invasion strongly influence patient prognosis [12, 23, 24]. Indeed, in the study by P. Kunjumohamed et al., survival in patients with multifocal tumors was 81% versus 83% in patients with unifocal tumors. Patients with tumors extending beyond the thyroid capsule had survival rates of 54.5% versus 85.6% in patients with tumors without extrathyroidal extension. Similarly, when vascular invasion was present, five-year survival was 46.7% versus 86.1% when it was absent [23].

According to ATA 2015 recommendations, high

postoperative Tg levels (>10–30 ng/mL) are associated with poor survival rates [25]. Our results reveal that patients with postoperative thyroglobulin levels >10 ng/ml have lower survival rates than those with detectable (>1 ng/ml and ≤10 ng/ml) and undetectable Tg levels. Five-year survival was 88% in patients with Tg >10 ng/ml versus 97% and 96% in patients with detectable (>1 ng/ml and ≤10 ng/ml) and undetectable Tg, respectively. Survival at ten years was 83% in patients with Tg >10 ng/ml versus 94% in those with detectable (>1 ng/ml and ≤10 ng/ml) and undetectable Tg. For Tg levels after treatment with radioactive iodine 131, the difference in survival was statistically significant for all three categories ($p < 0.001$). Patients with undetectable Tg levels after treatment had higher five-year and ten-year survival rates than those with detectable (>1 ng/ml and ≤10 ng/ml) and >10 ng/ml Tg levels after treatment. Survival rates at five and ten years were 97% and 95%, respectively, in patients with undetectable Tg, versus 93% and 91% in patients with detectable Tg (>1 ng/ml and ≤10 ng/ml), and 80% and 59% in patients with Tg >10 ng/ml. These results corroborate those of previous studies. Notably, the study by Wahba et al. [26] revealed that postoperative Tg level has a significant impact on five-year survival in differentiated thyroid cancers. They suggest that a Tg level ≥10 ng/ml reduces the patient's chances of reaching five-year survival ($p = 0.02$) [22]. Also, the study by Piccardo et al. [27] found that postoperative Tg level significantly influences overall survival. Survival at ten years was 68% in patients with Tg levels ≥50 ng/ml and 97% with Tg <50 [23].

Node involvement had an impact on survival rates. Survival rates at five and ten years for patients with N1 were lower than for those with N0: 86% versus 94% at five years and 79% versus 91% at ten years, respectively ($p < 0.001$). These results corroborate those of Links et al. [29] where N1 lymph node status compromises overall survival in patients with DTCs, with an odds ratio of 1.46 (0.89; 2.38). However, they contradict those of Mazurat et al. [16] and Cunningham et al. [28] who suggest that lymph node status does not influence the prognosis and long-term survival of patients .Also, the ATA concluded in its 2015 guideline, based on several studies, that the effect of the presence or absence of lymph node invasion on overall survival, if it exists, is small [25].

Log-rank test results revealed that distant metastases were associated with compromised survival. Patients who showed distant metastasis were unable to achieve five-year survival. These results are consistent with those reported by Mazurat et al. [16], Links et al. [29], Adam et al. [30] and Haigh et al. [18] who confirmed that the presence of distant metastases reduces overall survival and is associated with higher mortality rates [15, 17, 25, 26].

We classified our study population according to AJCC 8th edition, most of them were at stage I (94%). Interestingly, the results of the long-rank test indicated that five-year survival rates for patients classified as stage I were higher than those for stage II and III patients, 97% versus 66% and 37% ($p < 0.001$). The same results were observed for ten-year survival, notably for patients classified as stage I whose ten-year survival was 95% versus 55% for patients classified as stage II ($p < 0.001$). Patients classified as stage IV failed to achieve five-year survival, while those classified as stage III failed to achieve ten-year survival. Our data concur with those of Lundgren et al., who report that stage III compromises survival in patients with DTC [31]. Similarly, Tam et al., in a large population-based study of 2579 patients with FTDC, report that higher disease stages increase mortality rates, with ten-year survival rates of 94.3%, 66.8%, 40.6%, and 34.6% for stages I, II, III, and IV, respectively [32].

Furthermore, the classification of patients into risk groups according to ATA recommendations showed that patients at low risk of recurrence had higher survival rates than patients at intermediate or high risk (97%, 85%, and 72% at five years, and 95%, 80%, and 55% at ten years, respectively) ($p < 0.001$). In a systematic review, Pitoia and Jercovich reported similar findings, demonstrating that overall survival decreases with increasing risk of recurrence, associating groups at intermediate and high risk of recurrence with an incomplete response to treatment and a worse prognosis [33].

This study has certain limitations. We acknowledge that this study is limited by the fact that it concerns a single department. However, the large sample size and long follow-up period, with detailed clinical and pathological characteristics and assessment of response to treatment, provide an overview of the overall survival of Moroccan patients with DTC.

In conclusion, The findings of this study confirm the excellent prognosis and high survival rates of follicular differentiated thyroid cancers. However, overall survival is subject to a multitude of variables, such as gender, age, histological type, tumor size, extra-thyroidal extension, vascular invasion, postoperative Tg level, stage, risk of recurrence, and post-RAI therapy Tg level. These parameters also have an impact on therapeutic responses and recurrence rates. Therefore, a more in-depth analysis of recurrence-free survival in Moroccan patients will help to better identify the factors influencing the prognosis of DTC in Moroccan patients.

Author Contribution Statement

Conception and design: Hajar Tabiti , Amal Guensi,Karima Bendahhou. Collection and assembly of data: Hajar Tabiti. Data analysis and interpretation: All authors . Manuscript writing: all authors. Final approval of manuscript: all authors

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Ethical Approval

The study was conducted following ethical principles and was approved by the Biomedical Research Ethics Committee and the Ethics Committee of the Ibn Rochd University Hospital in Casablanca (Approval Nos. 02/2022 and 14/22).

Availability of Data

All data generated or analyzed during this study are

included in this article. Further enquiries can be directed to the corresponding author.

Conflict of Interest

The authors declare no conflict of interest related to this study.

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