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Assessment and Comparison of Thyroid Functions and Thyroid Antibodies for Patients Diagnosed with COVID-19 Disease who were Admitted in ICU and Those who were Admitted in Simple Ward

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Abstract

Background: SARS *can* cause multiple organ injury where the major organ affected is the lung. It has a deleterious effect on the thyroid gland. The viral infection and the thyroid gland-have a complex interplay through immunomodulatory signaling molecules and hormones.

Aim of Study: Was to evaluate the prevalence of thyroid dysfunction in patients infected with COVID-19 virus, compare thyroid function tests and thyroid antibodies in patients with COVID-19 disease admitted in ward and patients with COVID-19 disease admitted in ICU and its correlation with the demographic variables, comorbidities, and some laboratory tests.

Material and Methods: This cross-sectional study was conducted, including 200 patients diagnosed with COVID-19 virus disease admitted in both ward and ICU at Kasr Al-Airy Internal Medicine Isolation Hospital in Cairo, Egypt, from June 2021 to May 2022. Thyroid function tests, thyroid antibodies were done. Demographic, clinical, and laboratory data were analyzed.

Results: Sick euthyroid syndrome was the most common thyroid dysfunction among our patients. Serum levels of TSH and free T4 levels were significantly lower in ICU patients compared to ward patients (p-value: 0.044 and <0.001, respectively), while serum levels of total T3 and total T4 levels were significantly higher in ICU patients compared to ward patients (p-value s0.001 for both). Female gender, diabetes, serum level of total T4, and anti thyroglobin antibodies were associated with higher risk of ICU admission among COVID-19 patients. Total T3 was the most sensitive marker for ICU admission with 933% sensitivity while free T4 was the most specific marker for ICU admission with 70.3% specificity among the study group.

Conclusion: Thyroid dysfunction is prevalent in COVID-19 patients, with sick euthyroid syndrome being the most common thyroid dysfunction. There were significant differences in the serum levels of TSH, free T4 and total T3 and T4 between COVID-19 patients admitted in ward and those admitted in ICU. Total T3 was the most sensitive indicator while T4 was the most specific indicator for ICU admission. Early detection and treatment of thyroid abnormalities in patients with COVID-19 is crucial.

Key Words: COVID-19 — Thyroid functions — Thyroid antibodies.

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Introduction

THE coronavirus disease 2019 (COVID-19) pandemic, caused by the SARS-CoV-2 coronavirus, has a significant worldwide effect on healthcare systems and economics. The virus has significantly spread since its discovery in December 2019 in Wuhan, China, infecting millions of people and causing severe morbidity and death [1]. COVID-19 predominantly affects the respiratory system; however research shows that it may also influence other systems such as the endocrine system includingthe thyroid gland [2,3]. The thyroid gland is essential for metabolism, energy expenditure, and immune system function **[4].** Thyroid function abnormalities in COVID-19 individuals include primary and secondary hypothyroidism, hyperthyroidism, and non-thyroidal sickness syndrome (NTIS), which is known as sick euthyroid syndrome [3,5]. The presence of thyroid dysfunction in patients with COVID-19 can contribute to the severity and prognosis

of the disease [6]. However the link between SARS-CoV-2 and thyroid dysfunction is not yet completely known, and the prevalence of thyroid abnormalities in COVID-19 individuals varies from study to study **[7,8].**

Aim of the work:

This cross-sectional study evaluated the prevalence of thyroid dysfunction in patients infected with COVID-19 virus, comparing thyroid function tests in patients with COVID-19 disease admitted in ward and patients with COVID-19 disease admitted in ICU.

Patients and Methods

Study design:

This cross-sectional study was conducted at Kasr Al-Airy Internal Medicine Isolation Hospital between June 2021 and May 2022. It was approved by the ethical review board of Cairo University. It included 200 patients with COVID-19 disease.The study population was divided into two groups: 101 patients were admitted in the ward and 99 patients were admitted in the intensive care unit. Theirage rangedfrom 18-70 years. We excluded patients with history of any thyroid disorder or those receiving any thyroid replacement therapy or anti thyroid drugs, patients suffering from any malignant disease or pregnant females.

Data collection:

All patients had undergone history taking and full clinical examination. Presence of comorbid diseases such as diabetes and hypertension were assessed. Laboratory investigations included complete blood count (CBC), liver function tests, kidney function tests, Na, K, serum ferritin and CRP. Thyroid function including (TSH, Free T3, Free T4, Total T3, and T4) were done for all participants. Quantitation of Thyroid function tests were done in serum by ELISA Reference value of TSH was of range (0.39-6.61mIU/L), Total T3 range was (52-185ng/dl), Total T4 range was (4.4-10.8pg/dl). FT3 range was (1.4-4.2pg/m1) and FT4 range was (0.8-2ng/dl). In addition thyroid peroxidase and anti thyroglobin antibodies were done. All patients were diagnosed COVID-19 virus infection by chest CT scan and PCR test.

Statistical analysis:

In this study, SPSS version 28 was used to analyze the data. Means and standard deviations (or medians and ranges) were used to analyze numerical data, while numbers and percentages were used for categorical data. The frequency of events was also estimated using numbers and percentages. Assessment of data normality was done using Kolmogorov-Smirnov and Shapiro-Wilk tests, and chi-square or Fisher's tests were used to compare independent groups for categorical data. t-test was used for normally distributed numerical variables, while Mann-Whitney test was used for non-normally distributed numerical variable. Spearman's correlation coefficient was used to test the strength of association between non-normally distributed measurements, with different levels of correlation strength interpreted accordingly.

A stepwise logistic regression analysis was done to measure the independent effect of different factors on ICU admission, factors with a significance level less than 0.10 were selected to enter into the model. Logistic regression was used to determine adjusted odds ratios and the magnitude of the effect of different risk factors on ICU admission. Odds ratios and 95% confidence intervals (95% CI) were calculated, with a 95% CI that did not contain 1.0 considered significant.

Receiver operating characteristic (ROC) curves were used to determine the best cutoff point, sensitivity, specificity, and area under the curve. The accuracy of the test was measured by the area under the ROC curve, with different ranges used to classify the accuracy of the diagnostic test. A p-value of .0.05 was considered significant for all tests, which were two-tailed.

Results

A total of 200 patients with COVID-19 virus infection were included in this cross-sectional study conducted at Kasr Al-Ainy Internal Medicine Isolation Hospital, Cairo University, Egypt, from June 2021 to May 2022. The study group included 101 patients with COVID-19 disease who were admitted in simple ward in the isolation hospital and 99 patients with COVID-19 disease who were admitted in ICU. Both sexes were included 46.5% were females and 53.5% were males. The mean age of patients with COVID-19 disease was 55±15 year. Diabetes was found in 58% of cases and hypertension in 53.5% of cases, (Table 1).

Regarding laboratory data, 83.5% of cases were anemic, and 99%of cases had elevated CRP. Most ofthe cases had elevated kidney function, 82% had elevated urea and 68% had elevated creatinine levels. Elevated ferritin levels were found in 38.5% of cases. However, most cases had normal levels of Na, K, AST, and ALT.

Regarding the thyroid status of the study group, the most common thyroid dysfunction was the sick euthyroid syndrome which was observed in 111 cases (55.5%). Primary and secondary hypothyroidism were present in 3.5% and 8.5% of cases, respectively. Hyperthyroidism was present in 1.5% of cases. Subclinical hypothyroidism and hyperthyroidism were present in 1% and 2.5% of cases, respectively. Normal thyroid profile was present in 27.5% of cases (Table 2).

Comparing patients infected with COVID 19 virus admitted in ward with those admitted in ICU:

Our study revealed that the patients admitted in ICU were significantly older than in patients admitted to ward with a mean age of 57±14 and 52±15, respectively (p-value: 0.014). There was a statistically significant difference in gender distribution, with a higher proportion of female patients in the ICU (54.5%) and higher proportion of male patients in the ward (61.4%) (p-value: 0.033) (Table 1).

The laboratory data showed that the median total leucocyte count was significantly lower in ICU patients compared to ward patients (p-value: 0.002). Meanwhile, the median ferritin level was significantly higher in ICU patients compared to ward patients (p-value: 0.003). Regarding creatinine level, itwas significantly higher in ICU patients compared to wardpatients (p-value: <0.001). Also, AST and ALT levels show significantly higher level in ICU patients compared to ward patients (p-value: <0.001 and 0.009, respectively) (Table 2).

Table (1): Socio-demographic and comorbidities of the study group.

	Ward n=101 (%)	ICU n=99 (%)	*P*-value	All participant n=200 (%)
Age (Years):				
Mean ± SD	52±15	57±14	0.014	55-±15
Age group:				
s55 Year	57 (56.4%)	40 (40.4%)	0.025	97 (485%)
>55 Year	44 (43.6%)	59 (59.6%)		103 (515%)
Gender:				
Female	39 (38.6%)	54 (54.5%)	0.033	93 (465%)
Male	62 (61.4%)	45 (45.5%)		107 (535%)
Diabetes:				
Yes	53 (52.5%)	63 (63.6%)	0.117	116 (58%)
No	48 (47.5%)	36 (36.4%)		84 (42%)
Hypertension:				
Yes	54 (53.5%)	53 (53.5%)	0.992	107 (535%)
No	47 (46.5%)	46 (46.5%)		93 (465%)

SD: Standard deviation.
p-value <0.05 is considered significant.

Concerning thyroid function tests, TSH and free T4 show significantly lowerlevels in ICU patients compared to ward patients (p-value: 0.044 and <0.001, respectively), while total T3 and total T4 show significantly higher levels in ICU patients compared to ward patients (p-value: <0.001 for both). Anti-thyroglobin and Thyroid peroxidase antibodies levels were significantly higher in ICU patients with p-value <0.001 for both (Table 2). As for the comorbidities, there were no significant differences in the distribution of diabetes and hypertension among ward and ICU patients (Table 1).

Table (2): Thyroid profile for the study group.

	Ward n=101 (%)	ICU n=99 (%)	All participant n=200 (%)
TSH:			
Low	10 (9.9%)	15 (15.2%)	25 (12.5%)
Normal	86 (85.1%)	80 (80.8%)	166 (83%)
High	5 (5%)	4 (4%)	9 (4.5%)
Free T3:			
Low	49 (48.5%)	58 (58.6%)	107 (53.5%)
Normal	51 (50.5%)	41 (41.4%)	92 (46%)
High	1 (1%)	0 (0%)	1 (0.5%)
Free T4:			
Low	2 (2%)	19 (19.2%)	21 (10.5%)
Normal	97 (96%)	79 (79.8%)	176 (88%)
High	2 (2%)	1 (1%)	3 (1.5%)
Total T3:			
Low	25 (24.8%)	2 (22%)	27 (142%)
Normal	73 (72.3%)	84 (94.4%)	157 (82.6%)
High	3 (3%)	3 (3.4%)	6 (32%)
Total T4:			
Low	18 (17.8%)	10 (11.2%)	28 (14.7%)
Normal	80 (79.2%)	63 (70.8%)	143 (753%)
High	3 (3%)	16 (18%)	19 (10%)
Thyroid status:			
- Normal	34 (33.7%)	21 (21.2%)	55 (27.5%)
- Sick Euthyroid syndrome	55 (54.5%)	56 (56.6%)	111 (55.5%)
- Subclinical hypothyroidism	(2%)	0 (0%)	2(1%)
- Primary hypothyroidism	(3%)	4 (4%)	7 (3.5%)
- Secondary hypothyroidism	(3%)	14 (14.1%)	17 (8.5%)
- Subclinical hyperthyroidism	(2%)	3 (3%)	5 (2.5%)
- Hyperthyroidism	2 (2%)	1 (1%)	3 (1.5%)

TSH: Thyroid stimulating hormone.
SD : Standard deviation.
p-value <0.05 is considered significant.

The correlation coefficients for the association between ferritin and various laboratory parameters (Table 4).

Ferritin levels showed significant positive correlations with CRP, Hemoglobin, AST, Free T3 and Total T3 and a significant negative correlation with creatinine (Table 4).

Multivariate analysis:

Using multivariate analysis techniques, we aimed to determine the independent influence of various factors on ICU admission rates among COVID-19 patients. The factors with significant levels below the 0.100 were included in our stepwise logistic regression model (Table 5). Our analysis revealed that female gender, diabetes, total T4,

and anti-thyroglobin antibodies were significantly associated with higher risk of ICU admission among COVID-19 patients. Female patients had 2.1 times higher odds of ICU admission than male patients. Diabetic patients were 1.9 times more likely to be admitted to the ICU than nondiabetic patients. A one-unit increase in total T4 was associated with 1.2 times higher odds of ICU admission and a one-unit increase in anti-thyroglobin antibodies resulted in 2.0 times higher odds of ICU admission.

Table (3): Laboratory data of study group.

	Ward	ICU	*P*- value	All participant
	Mean ± SD			Mean ± SD
Hb (g/dl)	9.2±2.3	9.5±2.3	0.384	9.4±23
Plt (mcL)	22 1± 101	239±89	0.187	230±95
Na (mmol/L)	137±5.2	137±4	0.452	137±5
K (mmol/L)	4.4±0.8	4.3±0.7	0.522	434.1.7
	Median (range)			
TLC (cmm)	9 (2.4-26)	7 (1-66)	0.002	8 (1-66)
CRP (mg/L)	85 (5-220)	90 (5-254)	0.321	90 (5-254)
Ferritin (ng/ml)	340 (100-780)	400 (29-4523)	0.003	380 (29-4523)
Urea (mg/di)	90 (10-276)	110 (15-300)	0.092	90 (10-300)
Creatinine	1.8 (0.3-9)	2.8 (0.7-17)	<0.001	2 (03-17)
AST (U/L)	15 (1.6-200)	23 (7-103)	<0.001	20 (1.6-200)
ALT (U/L)	20 (8-368)	24 (0.9-170)	0.009	20 (0.9-368)
TSH (mIU/L)	1.4 (0-15.7)	1 (0.2-25)	0.044	1.1(0-25)
Free T3 (pg/ml)	1.4 (0.1-4.9)	1.2 (0.1-4)	0.217	12 (0.1-49)
Free T4 (ng/dl)	1 (0.3-3.2)	0.9 (0-3.3)	<0.001	1(0-33)
Total T3 (ng/dl)	69.6 (0.4-290.2)	88.8 (11.3-210.1)	<0.001	793 (0.4-2902)
Total T4 (ug/dl)	6.7 (0-15.1)	8.2 (0.2-13.1)	<0.001	7.4 (0-15.1)
TG (IU/ml)	0.3 (0.1-4.4)	0.6 (0.2-8.1)	<0.001	0.4 (0.1-8.1)
TPO (IU/ml)	0.2 (0.1-2.2)	0.3 (0.1-3.5)	<0.001	03 (0.1-35)

Hb : Hemoglobin. TLC: Total leucocytic count. TSH: Thyroid stimulating hormone.
PLT: Platelet. CRP: C-reactive protein. TG : Anti-thyroglobin antibodies.
Na : Sodium. AST: Aspartate aminotransferase. TPO: Thyroid peroxidase antibodies.
K : Potassium. ALT: Alanine transaminase. SD : Standard deviation.
p-value <0.05 is considered significant.

Table (4): Correlation of ferritin with other labs.

	Ferritin (ng/ml)	
	r	p-value
CRP (mg/L)	0.29	<0.001
TLC (cmm)	0.05	0.469
Hb (g/dl)	0.26	<0.001
PLT (mcL)	0.08	0.251
Urea (mg/di)	-0.12	0.093
Creatinine	-0.25	<0.001
Na (mmol/L)	-0.03	0.674
K (mmol/L)	-0.09	0.190
AST (U/L)	0.15	0.036
ALT (U/L)	0.08	0.239
TSH (mIU/L)	-0.03	0.685
Free T3 (pg/ml)	0.15	0.037
Free T4 (ng/dl)	-0.01	0.893
Total T3 (ng/dl)	0.14	0.060
Total T4 (ug/dl)	0.12	0.103
TG (IU/ml)	0.07	0.321
TPO (IU/ml)	0.05	0.467

Hb: Hemoglobin, PLT: Platelet, Na: Sodium, K: Potassium, TLC: Total leucocytic count, CRP: C reactive protein, AST: Aspartate aminotransferase, ALT: Alanine transaminase, TSH: Thyroid stimulating hormone, *r:* Correlation coefficient & ranges from -1 to +1, p-value <0.05 is considered significant. TG: Anti-thyroglobin antibodies, TPO: thyroid peroxidase antibodies.

Table (5): Shows the significant variables in the stepwise logistic regression.

	B	SE	OR	95% CI for OR	p-value
Female gender	0.7	0.3	2.1	1.1-3.9	0.025
Diabetes	0.7	0.3	1.9	1.1-3.7	0.042
Total T4 (ug/dl)	0.2	0.1	1.2	1.1-1.4	<0.001
TG (IU/ml)	0.7	0.3	2.0	1.2-3.4	0.008

B: Regression coefficient. CI: Confidence interval.
SE: Standard error. TG: Anti-thyroglobin antibodies.
OR: Odds ratio.

ROC Curve for Assessment of the Cutoff Point of Different Labs for ICU Admission: (Table 6 & Fig. 1).

Ferritin's AUC was 0.62, exhibiting a sensitivity of 60.6% and a specificity of 50.5%. The AUC for free T4 reached 0.69, with a 63.6% sensitivity and 70.3% specificity. For total T3, the AUC was 0.77 with 93.3% sensitivity and 60.4% specificity. Total T4 had an AUC of 0.67, a sensitivity of 64%, and a specificity of 58.4%. TSH's AUC was 0.58, demonstrating a sensitivity of 61.6% and a specificity of 51%. The AUC for anti-thyroglobin antibodies reached 0.73, with a 61% sensitivity and 65% specificity. The AUC for Thyroperoxidase antibodies reached 0.64 with a 60% sensitivity and 61% specificity.

Table (6): ROC curve for assessment of the cut-off point of different labs for ICU admission.

	Cut-off point	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	AUC	95% CI for AUC	p-value
Ferritin (ng/ml)	>340	60.6	50.5	54.5	56.7	0.62	0.55-0.69	0.003
Free T4 (ng/dl)	s0.9	63.6	70.3	67.7	66.4	0.69	0.63-0.76	<0.001
Total 3 (ng/dl)	>74.7	933	60.4	67.5	91	0.77	0.70-0.83	<0.001
Total 4 (ug/dl)	>7.2	64	58.4	57.6	64.8	0.67	0.60-0.74	<0.001
TG (IU/m1)	>0.41	61	65	60.7	653	0.73	0.66-0.79	<0.001
TPO (IU/m1)	>0.28	60	61	58	63	0.64	0.57-0.71	<0.001

TG : Thyroglobin antibodies.
TPO : Thyroid peroxidase antibodies.
PPV : Positive predictive value.
NPV : Negative predictive value.
AUC: Area under the curve.
CI : Confidence interval.
p-value <0.05 is considered significant.

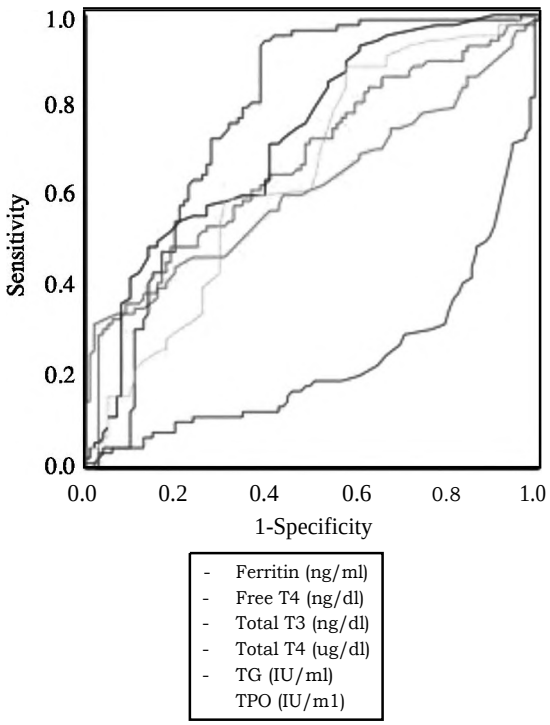

Fig. (1): ROC Curve determining the cut-off value of different labs in relation to ICU admission.

Discussion

SARS can cause multiple organ injury where the majororgan affected is the lung. It has a deleterious effect on the thyroid gland **[9].** The viral infection- and thyroid gland havea complex interplay through hormones and immunomodulatory signaling molecules **[10].** Thyroid hormones regulate adaptive immune and innate responses through both genomic and nongenomic mechanisms [11]. We assessed the prevalence of thyroid dysfunction in 200 patients diagnosedas COVID-19 disease, 101 patients who were admitted in simple ward and 99 patients who were admitted in ICU. Also weassessed the relationship between thyroid function abnormalities and disease severity by some laboratory tests.

In this studymore than half of the cases had sick Euthyroid syndrome in both ward and ICU patients (54.5% of ward patients and 56.6% of ICU patients). Acute illness can lead to variations in the plasma level of the thyroid hormones or TSH in the absence of underlying thyroid disease **[12].** Sick euthyroid syndrome or the non-thyroid illness syndrome (NTIS) consists of changes in the central component of the HPT axis with changes in thyroid hormones (TH) metabolism in a varietyof TH target organs [13]. It is themost common pattern where there is decrease in total T3 and free T3 levels, with normal levels of TSH and T4. Severe or prolonged illness may not only cause low T3 levels but also low T4/FT4 levels and low TSH levels often occur **[14,15].** Sick euthyroid syndrome is considered as an adaptive and protective mechanism to conserve the energy to an individual exposing to stress and in response to the state of catabolism **[15,16].**

Our findings were in agreement with Vassiliadi who found in his study that COVID-19 patients had a high prevalence of thyroid hormone abnormalities and the non-thyroidal illness syndrome (NTIS) was the most common abnormality **[5].** Chen reported a significant proportion of COVID-19 patients with subnormal TSH levels, which he suggested that this may be due to the influence of steroids used in the treatment of COVID-19 **[3].** On the contrary two other studies done by Khoo and Lui reported lower incidence of NTIS among COVID-19 patients, however these studies were doneinvolving non-critically ill-patients only, which may explain why the incidence of NTIS was low compared to our results **[6,17].**

Consistent hormonal alterations have been observed in SARS patients, including increase and decrease in adenohypophyseal and other hormones **[18].** In our study, primary hypothyroidism was diagnosed in 3.5% of patients, while secondary hypothyroidism was found in 8.5%. A study by Wei on deceased patients' pituitary cells due to SARS infection complications revealed significantly decreased TSH-positive cells in the SARS group **[19].** Hyperthyroidism was present in only 1.5% of cases and subclinical hyperthyroidism in 2.5% of cases. Normal thyroid profile was present in 27.5% of cases. In Lania's study subclinical hyperthyroidism

was present in 9.4% and subclinical hypothyroidism was present in 4.5% of the patients of his study **[8].**

Thyroid function tests can be affected by medications commonly used in the ICU, making interpretation of thyroid hormone challenging during illness **[20,21].** The concentration of T4 and T3 stimulate the production and release of cytokines. Cytokines leading to "cytokine storm" which is one of the main components of the systemic viral infections **[22,23].** The current study showed that plasma levels of TSH and free T4 levels were significantly lower in ICU patients compared to ward patients (p-value: 0.044 and <0.001, respectively), and free T3 was lower in ICU patients compared to ward patients but of no significant difference.Total T3, T4 show significantly higher level in ICU patients compared to ward patients (p-value: <0.001 for both).

Anti thyroglobin and thyroid peroxidase antibodies show significantly higher level in ICU patients compared to ward patient with p-value 4:1.001 for both. The molecular processes that may make individuals with COVID-19 more prone to developing autoimmune thyroid diseases (AITDs) resemble those that trigger autoimmunity in severe viral infections: Molecular mimicry, viral and bacterial super antigens that modify the T cell repertoire, and the death of lymphocytes followed by the growth of autoreactive lymphocytes **[24].** AITD is an autoimmune disease that is particularly relevant to COVID-19.

Lui and colleagues, detected elevated anti-thyroglobulin levels andanti-thyroid peroxidase (TPO) however there was no increase in anti-thyroid stimulating hormone receptor titers in his study **[25].** Vojdani's work found that 28 of 55 tissue antigens showed reactivity with SARS-CoV-2 antibodies, including thyroid tissue. Additionally, resemblances and homology were identified between SARS-CoV-2 proteins and human tissue antigens, such as mitochondria M2, F-actin, and TPO **[26].**

In our study there were differences between the percentage of patients who had low free T4, free T3, total T3 and total T4 between ICU patients and ward patients. More patients in the ICU had low free T4 and free T4 than patients in ward. On the other hand more patients in the ward had low total T3 and total T4 than in ICU patients.

Wang and his colleagues found that patients with SARS serum levels of TSH, T3 and T4 were significantly lower than those in the control group and that the level of T3 correlates with the severity of SARS. The lower the level of T3 the more severewas the disease. Different low levels of thyroid hormones were found according to the phase of disease: In the acute phase T3 and T4 levels were decreased, respectively, in 94% and 46% of patients and in 90% and 38% during the convalescent phase **[27].** In this study free T3 was decreased in 107 (53.5%) of all the patients Similarly a study by Gaofound that FT3, TSH and FT3/FT4 decreased with clinical deterioration of COVID-19 and that low FT3 level were independently associated with all-cause mortality in critically ill COVID -19 patients. Therefore appropriate management should be considered for patients who had lower FT3 concentrations to minimize the risk of death [28].

In our study anemia was found in 84.2 % of ward patients and 82.8% of ICU patients. Similar results was found by Gaetano's study as 61% of his COVID-19 patients had anemia **[29].** Ferritin and CRP which were used to assess the progression and severity of COVID-19 patients, CRP was elevated in 99% of cases. Ferritin level was higher in ICU patients than in ward patients. Its levels showed a significant positive correlation with CRP, hemoglobin, AST, Free T3 and Total T3. However its levels showed a significant negative correlation with creatinine. Studies by Chen and MO showed similar findings [30,31].

Fever and respiratory symptoms were the salient features of COVID-19, however involvement of other organs occurred. Our work showed that the majority of our cases had elevated kidney function. Studies showed that patients with COVID-19 had acute kidney impairment more common compared to patients with other coronavirus syndromes and that kidney impairment was associated with higher mortality **[32].**

Our results showedthat female gender, diabetes, and total T4 and anti thyroglobin antibodies were independent risk factors for ICU admission among COVID-19 patients. Female patients had 2.1 times risk of ICU admission than male patients. Diabetic patients were 1.9 times risk to be admitted to the ICU than nondiabetic patients. A one-unit increase in total T4 was associated with 1.2 times higher risk of ICU admission. A one-unit increase in anti thyroglobinantibodies resulted in 2.0 times risk of ICU admission. Total T3 was the most sensitive and Free T4 was the most specific marker marker for ICU admission with 93.3% sensitivity and 70.3% specificity respectively.

Limitations of this study were the small sample size, the conduction of this study in one hospital, the study only analyzed thyroid function tests at a single time point, potentially missing fluctuations in thyroid function over the course of the illness and not assessing the impact of thyroid dysfunction on patient outcomes as mortality, length of hospital stay, or the need for mechanical ventilation.

Conclusion: COVID-19 had a great effect on the thyroid gland. Early detection and treatment of thyroid abnormalities in patients with COVID-19 is crucial. Thyroid dysfunction was prevalent in COVID-19 patients, with sick euthyroid syndrome being the most common thyroid dysfunction. Female gen-

der, diabetes, total T4 and anti thyroglobin antibodies were predicators for ICU admission among patients with COVID-19 disease.

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تقييم ومقارنة وظائف الغدة الدرقية والأجسام المضادة للغدة الدرقية للمرضى الذين تم تشخيص إصابتهم بمرض كوفيد-١٩ والذين تم إدخالهم إلى وحدة العناية المركزة وأولئك الذين تم إدخالهم إلى العنبر

يمكن أن يصيب فيروس السارس العديد من الأعضاء، والعضو الرئيسي المصاب هو الرئة. و لكنه وجد أن له تأثير ضار على الغدة الدرقية. هناك تفاعل معقد بين العدوى الفيروسية والغدة الدرقية من خلال جزيئات الإشارة المناعية والهرمونات.

الهدف من الدراسة: تقييم مدى انتشار خلل الغدة الدرقية لدى المرضى المصابين بفيروس كوفيد-١٩، ومقارنة اختبارات وظائف الغدة الدرقية والأجسام المضادة للغدة الدرقية لدى المرضى المصابين بمرض كوفيد-١٩ المقبولين فى العنبر والمرضى المصابين بمرض كوفيد-١٩ المقبولين فى وحدة العناية المركزة وارتباطها بالمتغيرات الديموغرافية والأمراض المصاحبة وبعض الفحوصات المخبرية.

المواد والطرق: تم إجراء هذه الدراسة على ٢٠٠ مريض تم تشخيص إصابتهم بمرض فيروس كوفيد-١٩ وتم قبولهم فى كل من العنبر ووحدة العناية المركزة فى مستشفى قصر العينى الباطنى للعزل فى القاهرة، مصر، فى الفترة من يونيو ٢٠٢١ إلى مايو ٢٠٢٢. تم عمل الأجسام المضادة للغدة الدرقية. وقد تم تحليل البيانات الديموغرافية والسريرية والمخبرية.

النتائج: كانت متلازمة الغدة الدرقية المريضة هى الخلل الوظيفى الأكثر شيوعًا فى الغدة الدرقية بين مرضانا. كانت مستويات TSH ومستويات T4 الحرة فى الدم أقل بشكل ملحوظ فى مرضى وحدة العناية المركزة مقارنة بمرضى العنبر (القيمة p:0.044 و<٠,٠٠١، على التوالى)، فى حين كانت مستويات الدم T3 و T4 الكلى أعلى بشكل ملحوظ فى مرضى وحدة العناية المركزة مقارنة بالعنبر. المرضى (قيمة p ≥ ٠,٠٠١ لكليهما). ووجدت الدراسه أن المرضى ذى الجنس الأنثوى، والذى نيعانون من مرض السكرى من النوع الثانى، وكذلك المرضى الذين عندهم أرتفاع فى مستوى T4 الكلى فى الدم، والأجسام المضادة لثايروجلوبين معرضون اكثر لدخول وحدة العناية المركزة بين مرضى كوفيد-١٩. كان T4 الكلى هو العلامة الأكثر حساسية للقبول في وحدة العناية المركزة بحساسية ٩٣,٣٪ بينما كان T4 الحر هو العلامة الأكثر تحديدًا للقبول فى وحدة العناية المركزة مع خصوصية ٧٠,٣٪ بين مجموعة الدراسة.

الاستنتاج: يعد خلل الغدة الدرقية منتشرًا لدى مرضى كوفيد-١٩، حيث تعد متلازمة الغدة الدرقية المرضية هى الخلل الأكثر شيوعًا فى الغدة الدرقية. كانت هناك اختلافات ذو دلاله أحصائيه فى مستويات TSH و T3 الحر و T3 الكلى و T4 بين مرضى كوفيد -١٩ المقبولين فى العنبر وأولئك المقبولين في وحدة العناية المركزة. كان T3 الكلى هو المؤشر الأكثر حساسية بينما كان T4 هو المؤشر الأكثر تحديدًا للقبول بوحدة العناية المركزة. يعد الكشف المبكر عن أضطرابات الغدة الدرقية وعلاجها لدى مرضى كوفيد-١٩ أمرًا بالغ الأهمية.