



Original Contribution

Thyroid stimulating hormone testing in ED evaluation of patients with atrial fibrillation and various psychiatric diagnoses☆



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ABSTRACT

Background: Previous studies of thyroid stimulating hormone (TSH) levels in Emergency Department (ED) patients largely have centered on patients with atrial fibrillation (AF). In our ED patients with AF as well as patients with Psychiatric diagnoses (psych) are screened. The purpose of the present study was to compare TSH levels in the 2 groups. Our hypotheses were that an abnormal TSH and/or AF predicted the need for hospital admission and that TSH is more likely decreased in AF and increased in psych patients.

Methods: Our goal in the study was to compare the use of TSH testing in two ED populations, AF vs. psych patients. The study was a cross sectional cohort of AF vs. psych patients who had TSH levels drawn in the ED over a two year period. Our laboratory ranges were used to determine high vs. low TSH. Two chart examiners collected data after a training process. Charts were reviewed extracting demographic data, TSH levels, outcome (admit vs. discharge), history of AF, thyroid disease, psych diagnoses, presence of CHF, diabetes, hypertension. We compared AF vs. Psych groups using chi square and *t*-tests for parametric data. Odds ratios were calculated for comparisons between the 2 groups. For non-parametric data Mann Whitney U was used. A logistic regression was performed with the outcome of admission vs. discharge to find predictors of hospital admission. Kappa was calculated for inter-rater agreement. An a priori power analysis showed 80% power with 2 groups of 100 with an absolute difference of 20% between the 2 groups.

Results: 252 patients were included, 101 with AF and 152 Psych. Demographics differed in age only with AF patients being older. Mean TSH for AF vs. 2.4 for AF, 2.9 for psych (NS) with no differences in percentages with high or low TSH in the 2 groups. Fifty-three patients had abnormal TSH levels (21%), 27% of AF and 17% of Psych patients (NS). There were significant differences in incidence of CHF, DM, HTN, and tachycardia with more in the AF group ($P < 0.001$). Significantly more of the psych patients had a history of hypothyroidism (OR 2.28). Our logistic regression showed that taking into account demographics including age, the only predictors of admission were the presence of CHF (aOR 18.6) and having a diagnosis of AF (aOR 4.0).

Conclusion: There were no differences in TSH levels between the 2 groups. Twenty-one percent had an abnormal level. CHF and AF predicted hospital admission on regression analysis. Many with these AF or Psych diagnoses had abnormal ED TSH levels that could be useful in diagnosis, maintenance, or continuous treatment for their conditions diagnoses.

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1. Introduction

Thyroid-stimulating hormone (TSH) has become an urgent test that can be performed in the Emergency Department (ED) setting. However, the scope and limitations of this test have not been thoroughly investigated. Some question its usefulness in that it may not be of value in changing management. Others consider that the turnaround time for results may limit the utility of the test in the ED [1–3].

Previous studies on the efficacy of TSH testing in the ED have primarily focused on patients with atrial fibrillation (AF), the most common cardiac dysrhythmia that is sometimes caused by thyroid dysfunction. Giacomini et al. found urgent TSH testing in the ED useful for AF patients but felt a protocol for appropriate selective testing would be useful [1]. Bellew et al. found testing in the ED could be limited to patients with new onset AF or a history of thyroid disease with unknown TSH levels within the last 3 months [2].

Although several studies have been done to evaluate the usefulness of TSH testing in patients that present with AF in the ED, our study seeks to expand the scope of investigation by also evaluating the utilization of TSH testing in patients that present with psych diagnoses that have

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etiologies possibly linked to thyroid disease [1–4]. We found little in the literature about testing in psych patients in the ED and most of the literature was case reports [5,6]. We sought to compare AF and psych patients TSH levels on ED presentation.

Our primary aim was to determine whether an abnormal TSH level or a diagnosis of AF was more likely to lead to hospital admission. We also compared patients with a diagnosis of AF to those with a diagnosis of psych disorders to determine the likelihood of hypothyroidism and hyperthyroidism in these patient groups. We predicted that TSH is more likely to be decreased in patients with atrial fibrillation (due to hyperthyroidism) and increased in those with psych (due to hypothyroidism).

2. Methods

2.1. Study design and setting

Our study consisted of a cross sectional cohort analysis. Our goal was to compare the use of TSH testing in two ED populations, AF vs. psych patients. Using EMR inquiry, we searched for all patients who had TSH drawn during the two-year time period of June 2015 – May 2017. Out of that group, we then identified and included patients with documented initial TSH levels who had a diagnosis of either atrial fibrillation or psychiatric disease. The normal range of TSH in our laboratory is 0.358–3.74 tag ranges 3rd generation. Therefore, for this study abnormally low was defined as <0.358 and abnormally high was defined as >3.74. We then compared the atrial fibrillation cohort with the psychiatric cohort. Psychiatric disease was defined as one of the following diagnoses: agitation, anxiety, depression, psychosis, suicidal or homicidal ideation (SI/HI), miscellaneous psych disorder.

For the data collection process, we trained two chart examiners. Data was collected on a structured data collection form. Charts of the two cohorts were reviewed retrospectively, extracting demographic data, TSH levels, outcome (admit vs. discharge), history of AF, thyroid disease, psychiatric diagnoses, presence of CHF, diabetes, and hypertension.

2.2. Data analysis

We compared the AF and psych disease groups on all extracted variables. For dichotomous variables we used Chi square and *t*-tests (parametric data). Odds ratios were calculated for comparisons between the 2 cohorts. For non-parametric data we used the Mann Whitney U for comparisons between 2 groups. A logistic regression was performed with the outcome variable of admission to the hospital vs. discharge to find predictors of hospital admission. An a priori power analysis showed 80% power with two groups of 100 with an absolute difference of 20% between groups. Eight randomized charts were re-evaluated to determine inter-rater reliability and a kappa calculated.

The study was approved as exempt by our Human research review board.

3. Results

A total of 253 patients who had TSH levels drawn in the ED were included in the study, 101 with AF and 152 psych patients. Demographic comparison between the groups is shown in Table 1. There was no difference in the two groups in gender or race. Only age was significantly different between groups with psych patients being younger.

The psych diagnoses in our cohort included 6 with agitation, 31 with anxiety, 1 pure depression, 13 psychoses, 52 with SI/HI, and 49 with miscellaneous psych diagnoses.

The mean TSH for AF was 2.4; the mean for Psych disease was 2.9 (NS). The percentage of patients with elevated TSH and the percentage with low TSH was not significantly different between groups. Elevated TSH levels were found in 17% of AF compared to 13% of psych patients

Table 1
Demographics.

	All patients	AF	Psych	Sig (p)
N	253	101	152	
Male gender (%)	108	43 (43%)	65(43%)	NS
Age-mean	53 ± 19	66 ± 15	44 ± 17	P < 0.001
Race				NS
Caucasian	186	79	107	
Hispanic/Latino	1	0	1	
Native American	12	2	10	
Race unavailable	44	18	26	

(P > 0.05, NS). Low TSH was found in 10% of AF and 5% of psych (P > 0.05, NS). (See Table 2).

A new diagnosis of AF was found in 62 (62%) in the AF group but only 1 (<1%) of the psych disease group. Among both groups, 10 patients had a new diagnosis of thyroid disease by testing in the ED whereas 54 had a previously known diagnosis.

Significant differences in the 2 groups were found in incidence of CHF, DM, HTN, tachycardia and known history of thyroid disease, all with significantly more in the AF group. See Table 3.

Fourteen had a history of hyperthyroidism (9%, 12% AF, 4% psych, P > 0.05). Fifty-four had a history of hypothyroidism (33%, 26% of the AF group, 44% of the psych group, with significantly more in psych (P = 0.015, OR 2.28 (1.17–4.4) [with reference to psych group]). See Table 3. Table 3 shows all data with reference to the AF group.

AF patients were more likely to be admitted to the hospital (75% AF, 33% Psych) [P < 0.001 OR 12.9 (3–50.2)]. See Table 3.

Of 253 total patients 53 had abnormal TSH levels (21%). Seventy had a history of thyroid disease (28%). Of the 70 with a history of thyroid disease, 43% had an abnormal TSH level in the ED.

Because of the differences between the 2 groups, we conducted a logistic regression model to control for differences in co-morbidities and demographics. Controlling for age, gender, race and comorbid conditions of HTN, DM and known thyroid disease, the only significant predictors of admission on regression analysis were the presence of CHF (aOR 18.6 [(2.2–159)] and having a diagnosis of AF (aOR 4.0 [(1.7–9.4)]. Hosmer-Lemshow statistic was non-significant indicating a good fit with the data. (See Table 4).

There were 22 data items per subject on the extraction sheet. Assuming each question had a 50:50 chance of each of 2 possible answers, the kappa based on 8 charts extracted by 2 of the authors separately was 0.98, indicating extremely good inter-rater reliability to the data collection.

4. Discussion

In our study we compared those with AF to those with psych diagnoses for TSH levels in the ED. Previous studies have looked at AF but never psych diagnoses.

We found several surprises in our ED study. There was no difference in TSH in patients with AF vs. psych diagnoses. This is consistent with the study of Wu et al. wherein patients with major depression had BOTH hypo- and hyperthyroidism [7]. We expected there to be more elevated TSH in psych (hypothyroidism) and low TSH levels in AF (hyperthyroidism). This indeed was not the case, as there was no difference in

Table 2
TSH elevated or decreased AF vs. Psych.

	All patients	AF	Psych	P-value
N	253	101	152	
Mean TSH	2.7 ± 5.0	2.4 ± 2.2	2.9 ± 6.2	NS
Elevated TSH	14%	17.0%	13%	NS
Low TSH	6.7%	10%	5%	NS
Abnormal TSH	21%	27%	17%	0.06

Table 3
Diagnoses in the AF vs. Psych groups.

	All PTS	AF	Psych	OR (95%CI)	P-value
Known thyroid disease	14%	8%	19%	0.38 (0.16–0.8)	0.02
Hyperthyroid	9%	12%	4%	–	NS
Hypothyroid	33%	26%	44%	0.43 (0.23–0.96)	0.02
Psych history	32%	20%	41%	0.36 (0.199–0.65)	0.001
Previous Psych admit	17%	1%	28%	0.026 (0.003–0.19)	<0.001
CHF	12%	25%	3.4%	9.52 (3.49–26)	<0.001
DM	18%	31%	9%	4.4 (2.19–8.84)	<0.001
HTN	38%	72%	16%	13.3 (7.14–25)	<0.001
Tachycardia	30%	69%	3.4%	6.25 (2.3–166)	<0.001
Admission	50%	75%	33%	12.9 (3–50.22)	<0.001

mean TSH or the quantity of patients with abnormal TSH levels in AF vs. Psych groups (Table 2).

Unsurprisingly, AF patients were older, had more CHF, DM and HTN and more admissions. Also not surprising was the fact that presence of CHF and AF predicted admission in our regression analysis.

4.1. TSH and atrial fibrillation

Thyroid hormones work on the cardiovascular system either directly through thyroid receptors or indirectly through sympathomimetics, thus altering peripheral vascular resistance. This leads to increases in heart rate, hypertension, increased ventricular contractility, and an enlarged heart. Also undiagnosed hyperthyroidism is a risk factor for the development of atrial fibrillation [8,9]. Screening in the ED may lead to diagnosing previously unknown hyperthyroidism, thus allowing treatment to begin in a timely fashion. In our study 10 patients had a new diagnosis of thyroid disease and 62 had a new diagnosis of atrial fibrillation. Knowing TSH levels can help in diagnosis, management, determine admission to the hospital and certainly affect follow-up referral.

It is recommended that patients with AF and hyperthyroidism should receive anticoagulation. They are more likely to have cardioembolic events, thus diagnosis and treatment need to be expedited [10]. The ED may be the first presentation of these signs and symptoms and should be evaluated appropriately. Anticoagulants are often started in our ED after management of heartrate.

4.2. Previous ED studies of TSH in the ED for AF

There are a few studies of TSH in the ED for patients with atrial fibrillation [1–3,11]. Giacomini et al. present a quality improvement project and conclude that TSH determination in the ED was useful in ED decision making. However, they recommend targeted screening and finding clinical indications for that testing [1]. In that study TSH level was elevated in 9.9%, low in 6.7%, higher than that of the general population. Considering that ED patients present in acute illnesses, this is not surprising. Most of these patients were previously known to have abnormalities of thyroid function [1]. Bellew et al. present a decision rule for selective TSH screening [2]. They conclude that low TSH in AF patients presenting to the ED is rare (2%). They recommend testing in new

Table 4
Multivariable logistic regression of admission vs discharge as an outcome using disease related independent variables.

	aOR	95%CI	P value
Age (comparing a 10 year age difference)	1.16	0.91,1.47	NS
A Fib vs Psych disease groups	4.0	1.7,9.4	0.002
Known thyroid disease	1.6	0.6,4.2	NS
Psych diagnoses	1.5	0.7,3.1	NS
CHF	18.6	2.2159.8	0.008
DM	1.2	0.5,3.1	NS
HTN	1.1	0.5,2.5	NS

onset AF or those with a history of thyroid disease who do not have a known TSH level within 3 months of their ED presentation [2]. However in our study abnormal TSH levels were seen equally in patients with AF and psych disorders. While we did not look at whether TSH levels were known prior, many had abnormalities that may have contributed to their ED visit and/or follow-up care. Buccelletti et al. showed that hyperthyroidism was present in nearly 10% of new-onset AF patients in the ED and recommend screening all new onset AF patients [3]. They site that patients with AF have a high risk of previous thyroid disease, CVA and hypertension and these factors may help to identify those at high risk of having a low TSH [3]. In a review by Pimental and Hansen the authors conclude that TSH assays are sensitive and that there should be development of evidence-based guidelines for appropriate testing [11].

4.3. TSH and psychiatric diagnoses

There is a known association between thyroid function and psychiatric diagnoses. We could find no articles about ED detection of high or low TSH in ED psych patients. In our ED, psych patients are often screened for thyroid dysfunction if they are to be admitted to the Psychiatric facility. Previous study shows the link between thyroid dysfunction and depression. Patients with thyroid dysfunction are known to develop depressive symptoms more readily and some of the thyroid dysfunction can be subclinical or subtle. Hage et al. conclude that screening in those with refractory depression is reasonable [12]. Wu et al. found that patients with major depressive disorder had a higher prevalence of hypothyroidism OR hyperthyroidism than the general population [7]. In a retrospective cohort of 13,000 patients, Kim et al. found that low thyroid function and those with high TSH had a higher risk of depressive symptoms although these were not in an ED setting [13]. Wynsokinski et al. studied TSH levels in patients with schizophrenia, depression, and bipolar psych disorders [4]. In this study they found that there was a higher prevalence of TSH abnormality in patients with mood disorders vs. schizophrenics; however, both had abnormalities in directions and frequency of thyroid dysfunction [4].

ED studies of psych disorders include case reports about bipolar disorder and hyperthyroid rage [6] and a case of subacute thyroiditis presenting as acute psychosis [5]. Little else is presented about psych patients and TSH in the ED, making our study unique. Many of our psych patients had abnormal TSH levels in either direction, which could lead to exacerbation of an underlying psychiatric condition. We were expecting mostly high TSH levels, but this was not the case. This is consistent with the study of Wu et al. [7]. Early diagnosis and treatment may be of value in those with severe symptoms.

5. Conclusion

There was no difference in TSH levels between AF patients and psychiatric disease patients. AF patients were more likely to be older, be admitted and have other complications requiring admission. Both AF and psych patients may have equivalent numbers of abnormal TSH levels on presentation to the ED, with a trend toward more abnormal values in AF patients. Among all the included variables only a diagnosis of CHF or A Fib was predictive of hospital admission. TSH levels in the ED could be helpful in diagnosis, maintenance, or continuous treatment for either AF or Psych diagnoses.

6. Limitations

Since this study was retrospective cause and effect cannot be assigned. We were not able to determine whether or how abnormal (or normal) values were acted upon. This data was not available to us and thus is a limitation to the study.

The ultimate etiology for TSH abnormalities may not be ascertainable in retrospect. However all patients had a diagnosis of AF or a Psych diagnosis and this was supported by the dispositions.

Not ALL AF or psych patients may have had TSH drawn; it is unknown who was excluded or why. We included those who had them drawn in the ED to demonstrate the usefulness and perhaps encourage physicians to at least consider sending them in those with these diagnoses. They may be useful in management.

It is unknown who was treated because of TSH levels although it is likely patients were referred if needed. Many with AF were admitted; however we did not look at inpatient records to determine if medications were altered during hospital stay or discharge. Future study could consider looking at this outcome as well. It is thus uncertain who was adequately treated for thyroid disease.

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