THE VALUE OF BEDSIDE ULTRASOUND IN THE DIAGNOSIS OF THYROTOXICOSIS AND THYROTOXIC CARDIAC EMERGENCIES- A SHORT-TERM STUDY

Muhammed Mushthaque P[1], Kunhi Kannan[2]

[1]Associate Professor, Department of General Medicine, Kannur Medical College, Anjarakandy, Kannur, Kerala.
[2]Associate Professor, Department of General Medicine, Kannur Medical College, Anjarakandy, Kannur, Kerala.

ABSTRACT

BACKGROUND

Many times in ICU patient's thyrotoxicosis is suspected and its diagnosis is hindered by many fallacies of clinical examination and lab reports. This happens especially with cardiac emergencies. The role of Ultrasound examination of thyroid in ICU patients admitted for different causes needs to be studied elaborately.

AIM

To assess the thyrotoxic burden in the ICU of suspected thyroid disease in patients; find out the benefit of thyroid ultrasound in evaluating thyrotoxicosis in patients of cardiac emergency.

MATERIALS AND METHODS

94 patients admitted in 2 ICU units from November 2015 to October 2016 were evaluated. Irrespective of the cause for admission to ICU all the patients suspected to have Thyrotoxicosis on clinical and lab values were assessed with Ultrasound examination of the Thyroid. All patients were subjected to Thyroid function tests, and volumetry of both lobes of thyroid. Echocardiography and continuous ECG monitoring was done.

RESULTS

94 patients admitted to ICU, 67.02% had cardiogenic cause for admission. 56.38% of the total 94 patients were suspected to have thyrotoxicosis depending upon their clinical and lab features. 27.65% of these were confirmed later of Thyrotoxicosis. 47.61% of the thyroid suspicion patients had cardiogenic cause for their admission. 17 patients had grave's disease and 9 patients showed thyroid nodule. The sensitivity of thyroid USG in diagnosis of thyrotoxicosis was 100%.

CONCLUSION

Bedside USG is a quick and very valuable noninvasive investigation in early, rapid and accurate diagnosis of thyrotoxicosis and thyrotoxicosis emergencies.

KEYWORDS

Thyrotoxicosis, Thyroid Ultrasound, Thyrotoxic Cardiac Emergencies, ICU.

HOW TO CITE THIS ARTICLE: Mushthaque PM, Kannan K. The value of bedside ultrasound in the diagnosis of thyrotoxicosis and thyrotoxic cardiac emergencies- a short-term study. J. Evid. Based Med. Healthc. 2017; 4(6), 269-273. DOI: 10.18410/jebmh/2017/51

BACKGROUND

Hyperthyroidism is the second commonest endocrinal disorder encountered in Medicine practice after Diabetes Mellitus. The most common causes are diffuse toxic goiter (Graves' disease) (GD) (~1%), solitary toxic nodules (STN) (~0.1%) and toxic multinodular goiter (TMG) (~0.53%).[1] Even though thyrotoxicosis is not a common cause for admission to an ICU, it remains a major uncommonly suspected disease requiring thorough search in many admitted patients. It is because there is overlap of symptoms and signs of thyrotoxicosis with many diseases in critical care patients. They are those with severe cardiac and chest diseases and patients with cardiac neurosis such as tachycardia, arrhythmias, dyspnoea, sweating, weight loss, nervousness, severe anxiety and panic, staring look, collapsing pulse and hand tremors. In few patients thyrotoxicosis may not be clinically manifest (subclinical or masked) especially in old age. If not diagnosed in such situations may aggressively deteriorate the condition of ill patients like those with malignant arrhythmias, severe heart failure and acute coronary syndromes.[2,3] In some thyrotoxic patients initially may clinically present with thyrotoxic cardiac complications like atrial fibrillation, ventricular tachycardia, atrial or ventricular ectopics, and thyrotoxic heart failure with absence, or even not clinically prominent, common thyrotoxic symptoms.[4,5] The commonest sign of thyrotoxicosis, thyromegaly may not be evident in about one half of thyrotoxic patients.[1] If Thyrotoxicosis is in mild (early) form; Grave's diseases in critically ill patients or patients with pretoxic thyroid nodules the management of critically ill

Financial or Other, Competing Interest: None.
Submission 08-01-2017, Peer Review 10-01-2017,
Acceptance 13-01-2017, Published 17-01-2017.
Corresponding Author:
Dr. Muhammed Mushthaque P,
Associate Professor,
Department of General Medicine,
Kannur Medical College,
Anjarakandy, Kannur, Kerala.
E-mail: drmushtaque@hotmail.com
DOI: 10.18410/jebmh/2017/51

cardiac patients becomes difficult. This conflict is caused by the inconsistent laboratory findings of thyroid hormones and TSH due to acute disruption of the normal steady state of these hormones.[6,7,8,9] Sometimes delay in the assessment of thyroid hormones by the laboratories by a day or two is another problem in early diagnosis of thyrotoxicosis in seriously ill patients. Thyroid ultrasound (US) which is as an adjunctive tool to assess different thyroid diseases is a rapid, safe, feasible, easily available and informative. In many cases if performed by expert personnel.[10,11,12,13,14]

AIM OF THE STUDY

Study aimed to assess the thyrotoxic burden in critically ill patients admitted in ICU. To evaluate the value of thyroid ultrasound as a bedside diagnostic tool in early evaluation of suspected thyroid disease in critically ill patients especially those with life threatening cardiac emergencies.

MATERIALS AND METHODS

94 patients who had been admitted to the ICU Department of Medicine of Private General Hospital attached to Kannur Medical College, Anjarakandy, Kannur through casualty are included in the study. Patient's consent was obtained in all cases. Institutional ethical committee clearance was obtained. Among the ICU patients those suspected to have thyrotoxicosis were selected and thoroughly studied.

Inclusion Criteria

1. Patients with thyrotoxic symptoms and signs (Insomnia, palpitations, panics, nervousness, weight loss, appetite changes, sweating, heat intolerance). 2. Patients on antithyroid drug therapy, T4 therapy. 3. Past history of thyroid disease or thyroid operation, presence of goiter or thyrotoxic eye signs or other suspecting thyrotoxic symptoms and signs. 4. Patients with persistent unexplained sinus tachycardia, or presence of atrial fibrillation, PSVT, atrial or ventricular premature beats, ventricular tachycardia or ventricular fibrillation at presentation or during ICU admission.

Exclusion Criteria

1. Patients undergoing tracheotomy were not included. 2. Patients with Thyroid malignancies were also excluded. All the patient's attendants were asked about thorough history of the illness followed by patient's clinical assessment including general examination including heart, chest, abdominal and neurological examination. Local thyroid examination using WHO 1960 palpation criteria for determination of goiter: (group 0: thyroid gland not palpable or visible; IA: thyroid gland is only palpable but not visible; group IB: thyroid gland is palpable and visible with neck only in raised position; group II: thyroid gland is palpable and visible with neck not in raised position; group III: gross enlargement of the thyroid gland).[15] Thyrotoxic cardiac emergencies were considered when there was cardiac emergency suspected to be caused or compromised by thyrotoxicosis (e.g. cardiac arrhythmias, heart failure). Thyroid function tests including FT3, FT4, TSH done on the day of ICU admission and if needed on the day of discharge. Other laboratory investigations performed were serum sodium and potassium, arterial blood gases. In addition all regular and required investigations were done according to the needs of patients. Thyroid ultrasound was ordered in suspected thyrotoxicosis patients. Echocardiography was done in all cardiac patients. Continuous ECG monitoring was recorded in all patients. Standard methods were used in performing Thyroid ultrasonography.[16,17,18] Goiter was declared when the total thyroid volume was more than 25 ml in males and 18 ml in females,[17,18] Standard statistical methods were used in analyzing the data.

RESULTS

94 patients included in the present study belonged to the age groups of 24 to 74 years with a mean age of 63.4±2.1. Out of these 94 patients 53 were evaluated for thyrotoxicosis due to clinical suspicion of thyroid involvement. The demographic data and the various causes for admission to the ICU are displayed in Table 1. Out of 53 patients evaluated for thyrotoxicosis 31/53 patients (58.38%) were evaluated for suspected Goiter. This amounted to 32.97% of the total patients admitted to the ICU. Among these 31 patients the ultrasound thyroid results showed Graves' disease (GD) with evident Goiter in 17 (54.83%), Thyroid nodules in 9 (29.03%) and Diffuse simple Goiter in 5 (16.21%) patients. Among those patients who were not suspected of having a Goiter 11 patients were proved to be having, 2 showed small nodules and the remaining 9 (40.90%) without Goiter (Table 1).

Gender		**Age**	
Males	Females	<55 Yrs.	>55 Yrs.
64.15%	35.85%	56.60%	43.40%
Main Causes of Admission- 94		Anti Thyroid therapy	
*Cardiac Critical Care	63 (67.02%)	On therapy	Discontinued
Arrhythmias	31 (49.20%)	7 (7.47%)	16 (16.98%)
Heart Failure	14 (22.22%)	Clinical suspicion of Thyrotoxicosis	53 (56.38%)
Acute Chest pain	11 (17.46%)	*Suspected Goiter	31 (58.49%)
Malignant Hypertension	4 (6.34%)	Graves Disease Evident Goiter	17 (54.83%)
Unstable Angina	3 (4.76%)	Thyroid nodules	9 (29.03%)
*Respiratory Failure	9 (9.57%)	Diffuse simple Goiter	5 (16.21%)
*Cerebro Vascular Accident	10 (10.63%)	*Suspected Thyrotoxicosis without Goiter	22
*Shock	4 (4.25%)	Proved later to have Goiter	11 (50%)
*Acute Renal failure	4 (4.25%)	No Goiter	9 (40.90%)
*Diabetic Ketoacidosis	4 (4.25%)	Solitary Thyroid nodule	2 (9.09%)

Table 1. Showing the Demographic Data, Main Causes of Admission to ICU, and Incidence of Suspected and Proven Goiter (n=94)

The Goiter range was classified according to WHO classification; ranging from grade IB to grade III. Goiter was said to be present in a patient when the thyroid volumetry showed increased total thyroid volume more than 25 ml in males and 18 ml in females).[17,18] Graves' disease was observed in 17 (54.83%) patients out of 31 suspected goiter patients; 10 male and 7 female. Out of these 11 patients showed clinically evident goiter (grade 1-3) and 6 were graded as 0 but Ultra sound examination showed increase thyroid volume in all these patients ranging from 25 to 74 ml (Table 2).

Parameter	Number and % in Relation to Suspected and Proven Method Used
Clinically suspected to have Goiter with Graves' disease (n=94)	17/94
Ultrasound proved Graves' disease	17/17 (100%)
Clinically evident goiter	11/17 (64.70%)
Clinically missed goiter	6/17 (35.29%)

Table 2. Showing the Diagnosis of Graves' disease in Suspected Thyrotoxicosis Patients assessed by Ultrasound and Clinical Methods n= (17/94)

Thyroid nodules were found in 9/31 patients (29.03%) which were definite toxic nodules (8 females and 1 male). Out of these 6 could be clinically detected (grade 1-3) and the remaining missed the diagnosis (grade 0,) (Table 3).

Parameter	Number and %
Toxic and Pre Toxic Nodules	9
All cases	9/94 (9.57%)
Toxic cases	6/9 (66.66%)
Pretoxic cases	3 (33.33%)
Toxic and Pretoxic solitary nodules	5/9 (55.55%)
Toxic and Pretoxic Multinodular nodules	4/9 (44.44%)
Clinically detected thyroid nodules	6/9 (66.66%)
Clinically missed thyroid nodules	3/9 (33.33%)

Table 3. Showing Diagnosis Clinically and Ultrasound Examination (n=9/94)

Thyroid nodules were solitary in 5 cases (55.55%) and multinodular in 6 cases (66.66%). Nodule volumes ranged 13.4–34.9 ml and 10 of them (N: 10) (90.9%) were hyperechogenic in nature and in one case was isoechogenic. 5 cases (45.5%) had nodules with a peripheral halo (reflecting normal compressed thyroid tissue).

Out of the 94 admissions to the ICU 63 patients were admitted for cardiogenic causes. Out of these 31 patients were admitted with Arrhythmias, 14 with Heart Failure, 11 with Acute Chest pain, 4 with Malignant Hypertension and 3 with Unstable Angina. Out of these 63 patients, thyrotoxicosis was proved in 18 patients (28.57%). In the remaining patients admitted to ICU with causes other than Cardiogenic nature 31 (32.97%) thyrotoxicosis was proved in 4 (12.90%). Among the 53 patients of ICU suspected to have Thyrotoxicosis many had tachyarrhythmia (with one or more forms, including life threatening arrhythmias) and some were on antiarrhythmic drugs. In addition, six proved thyrotoxicosis patients had heart failure. One proved thyrotoxicosis patient had STEMI. Among the 94 patients admitted in ICU 53 patients were suspected to be thyrotoxicosis (56.38%). Of these 53 patients, 17 had Graves' disease (54.83%) and 9 patients had toxic nodules (16.98%). This gives a total positive confirmation of thyrotoxicosis as 26/94 (27.65%), (Table 4).

Parameter	Number & % of ICU Admitted Patients (n=94)	% Related to Suspected Patients (n- 53) (%)	% Related to all Proven Patients (n- 26) (%)
Graves' disease (all patients)	17/94 (18.08%)	17/53 (32.07%)	17/26 (65.38%)
Patients with toxic nodules (all patients)	9/94 (9.575)	9/53 (16.98%)	9/26 (34.61%)
All thyrotoxicosis patients	22/94 (23.40%)	22/53 (41.50%)	22/26 (84.61%)
Patients with masked thyrotoxicosis	14/94 (14.89%)	14/53 (26.41%)	14/26 (53.84%)
Thyrotoxicosis			
- With clinically evident goiter	31/94 (32.97%)	31/53 (58.49%)	26/26 (100%)
- With clinically missed goiter	17/94 (18.08%)	17/53 (32.07%)	17/26 (65.38%)

Table 4. Showing the Final USG Results Against the Total ICU, Suspected Thyrotoxicosis (n=94)

When the comparison accuracy of USG was compared with clinical assessment of thyrotoxicosis in 94 patients admitted in ICU the true positive on clinical examination was 46% against true negative of 42%. The sensitivity of clinical examination was 86% against the USG of 100%. The specificity of clinical examination was 68.8% against the USG of 100%. The true and false negative parameters of clinical assessment of thyrotoxicosis were not assessed as this would need laboratory assessment of all admitted patients. Hence, sensitivity, specificity, negative predictive value and overall accuracy of the clinical evaluation could not be assessed (Table 6).

Parameter	Clinical Examination %	Ultrasound Examination %
True positive	46	52
True Negative	42	65
False Positive	10	0
False negative	18	0
Sensitivity	86%	100%
Specificity	68.8%	100%
Positive predictive value	69%	100%
Negative predictive value	64.34%	100%
Overall accuracy	75%	100%

Table 5. Showing the Comparison of Accuracy of Diagnosis between Clinical Examination and Ultrasound Examination among 53 Patients Suspected to have Thyrotoxicosis (n=53)

DISCUSSION

The main aims of the study were to assess the thyrotoxicosis burden in ICU patients and to assess the role of thyroid ultrasound as a rapid and feasible bedside diagnostic tool in accurate and early evaluation of suspected thyroid disease especially in cardiogenic causes. The diagnosis of thyrotoxicosis is usually based on clinical, laboratory, FNAC and USG parameters. Thyroid isotope studies are less commonly used by the clinicians and are not possible in ICU patients. The chances of fallacies in clinical and lab investigations are well known and use of isotope studies is very limited in ICU patient's altogether. In such situations USG of thyroid in bedside diagnosis of thyrotoxicosis in emergency situations should be emphasized. Osama M Mumtaz.[19] et al conducted a study of this kind first time to assess the feasibility of thyroid USG in the diagnosis of thyrotoxicosis in emergency settings. It is important to know the burden of thyrotoxicosis presenting in critically ill patients especially cardiac patients. Disparities and delays in clinical evaluation of patients and laboratory investigations sometimes lead to delay in confirming the existence of thyrotoxicosis in critically ill patients and in turn delays treatment. In such situations a rapid, feasible accurate bedside confirmatory test allows a much needed guidance in critically ill patients.[19] Thyrotoxicosis burden in the general ICU in our study was found in 56.38% of all 94 admitted patients. Final diagnosis of thyrotoxicosis was proved in 27.65% of suspected cases. Out of 94 patients 56.38% had masked thyrotoxicosis symptoms and signs and could be easily overlooked. In a similar study of prevalence of thyroid disease in 2805 attendants of the outpatient clinic of Internal Medicine Department in El-Minia University Hospital, 1.06% had GD and 0.64% had toxic nodules.[20] Thus, thyrotoxic burden in the ICU was found to be about double the burden encountered in the outpatient clinic.[20] This proves the impact of thyroid dysfunction on co-morbid conditions of ICU admissions and/or the impact of co-morbidity on unmasking or aggravating thyrotoxicosis. Among the 53 (56.38%) ICU patients with clinical suspicion of thyrotoxicosis 25 (47.16%) had cardiogenic causes especially cardiac arrhythmias 18 (33.96%). This finding highlights the concurrent existence of cardiac arrhythmias and increased occurrence of thyrotoxicosis among patients with various tachyarrhythmia. Sinus tachycardia which occurs in nearly all patients and AF which occurs in 5–15% of thyrotoxic patients as reported by different population studies.[21] Thyroid ultrasound had proved to be beneficial in diagnosis of goiter. Goiter is defined as thyroid enlargement of more than 18 ml in females and 25 ml in males.[17,18] Diagnosis of thyroid nodules (solitary and multiple) was accurately done by USG. This helped to clinch the diagnosis of toxic thyroid nodules for early management of thyrotoxicosis. Amiodarone is commonly used in treatment of supraventricular and ventricular arrhythmias and may induce thyrotoxicosis in patients with thyroid nodules even if the nodule is nontoxic as it is an iodine containing drug.[22] The benefit of USG clearly was evident in STEMI, malignant arrhythmias and refractory heart failure patients in this study. The sensitivity of thyroid USG in diagnosis of thyrotoxicosis was 100%, negative predictive value 100% and overall accuracy 100% compared to a positive predictive value of 69% for clinical assessment addressing the invaluable diagnostic role of USG. On the other hand, diagnosis of goiter per se by clinical examination had a sensitivity 84%, specificity 68.8%, positive predictive value 69%, negative predictive value 64.34% and overall accuracy 75% compared to 100% for all these accuracy parameters of US emphasizing the role of US as the gold standard for the diagnosis of goiter.

CONCLUSIONS

Thyrotoxicosis is encountered in ICU not uncommonly. Masked cases should be thoroughly searched for especially in cardiac patients. Bedside USG is a quick and very valuable non invasive investigation in early, rapid and accurate diagnosis of thyrotoxicosis and thyrotoxic emergencies.

REFERENCES

[1] Kaplan MM. Clinical and laboratory assessment of thyroid abnormalities. Medical Clinics of North America 1985;69(5):863-880.
[2] Cappola AR, Fried LP, Arnold AM, et al. Thyroid status, cardiovascular risk, and mortality in older adults. JAMA 2006;295(9):1033–1041.
[3] Olshausen KV, Bischoff S, Kahaly G, et al. Cardiac arrhythmias and heart rate in hyperthyroidism. Am J Cardiol 1989;63(13):930-933.
[4] Alfadhli E, Gianoukakis AG. Management of severe thyrotoxicosis when the gastrointestinal tract is compromised. Thyroid 2011;21(3):215-220.
[5] Wyne K. Commentary: the role of thyroid hormone therapy in acutely ill cardiac patients. Crit Care 2005;9:333-334.
[6] Stathatos N. The controversy of the treatment of critically ill patients with thyroid hormone. Best Pract Res Clin Endocrinol Metab 2001;15(4):465-478.
[7] Nylen ES, Mullar B. Endocrine changes in critical illness. J Intensive Care Med 2004;19(2):67-82
[8] Ligtenberg JJM. Hormones in the critically ill patient: to intervene or not to intervene. Intensive Care Med 2001;27(10):1567–1577.

[9] Sakharova O, Inzucchi SE. Endocrine assessments during critical illness. Crit Care Clin 2007;23(3):467-490.
[10] Thyroid/Parathyroid Ultrasound. American College of Radiology Practice Guideline. 2007. http://www.acr.org/SecondaryMainMenuCategories/quality_safety/guidelines/us/us_thyroid_parathyroid.aspx.
[11] Eng CY, Quraishi MS, Bradley PJ. Management of thyroid nodules in adult patients. Head Neck Oncol 2010;2:11.
[12] Frates MC, Benson CB, Charboneau JW, et al. Management of thyroid nodules detected at US: Society of Radiologists in Ultrasound consensus conference statement. Radiology 2005;237(3):794–800.
[13] Ross DS. Nonpalpable thyroid nodules-managing an epidemic. J Clin Endocrinol Metab 2002;87(5):1938–1940.
[14] Tessler FN, Tublin ME. Thyroid sonography: current applications and future directions. AJR Am J Roentgenol 1999;173(2):437-443.
[15] Zimmermann M, Saad A, Hess S, et al. Thyroid ultrasound compared with World Health Organization 1960 and 1994 palpation criteria for determination of goiter endemic goiter prevalence in regions of mild and severe iodine deficiency. Eur J Endocrinol 2000;143(6):727-731.
[16] Chanoine JP, Toppet V, Lagasse R, et al. Determination of thyroid volume by ultrasound from the neonatal period to late adolescence. Eur J Pediatr 1991;150(6):395-399.
[17] Hegedus L. Thyroid size determined by ultrasound. Influence of physiological factors and non-thyroidal disease. Dan Med Bull 1990;37(3):249-263.
[18] Hintze G, Windeler J, Baumert J, et al. Thyroid volume and goitre prevalence in the elderly as determined by ultrasound and their relationships to laboratory indices. Acta Endocrinol Copenh 1991;124(1):12-18.
[19] Momtaz OM, Taha NM, Helmy AK. Thyrotoxic burden in the ICU and the value of bedside thyroid ultrasound in the diagnosis of thyrotoxicosis and thyrotoxic cardiac emergencies in critically-ill patients. The Egyptian Journal of Critical Care Medicine 2013;1(3):129-138.
[20] Hamed ES, Abdel-Wahab AM, Salama AS, et al. Prevalence of thyroid disease among attendants of El-Minia university hospital. EL-Minia Med Bull 1998;9(1):40-52.
[21] Vanderpump MP. The epidemiology of thyroid disease. Br Med Bull 2011;99:39-51.
[22] Roffi M, Cattaneo F, Topol J. Thyrotoxicosis and the cardiovascular system: subtle but serious effects. Clevland Clin J Med 2003;70(1):57-63.