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Original Research Article

Incidence of left ventricular diastolic dysfunction in patients with subclinical hypothyroidism

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ABSTRACT

Background: Subclinical hypothyroidism (SCH) is a common endocrine disorder categorized by increased serum thyroid-stimulating hormone (TSH) levels with normal free thyroxine (FT4) levels. The study determined the prevalence of LVDD in females aged 20 to 50 years with SCH and to explore the relationship between serum TSH levels and left ventricular diastolic dysfunction (LVDD).
Methods: One hundred female participants aged 20 to 50 years with SCH were included in this study conducted between September 2014 to October 2015. All participants underwent 2D echocardiography to assess diastolic function. Data were collected on age, serum FT3, FT4, TSH levels, and echocardiographic parameters. Statistical analysis was achieved using SPSS.
Results: The study found that 34% of the participants had LVDD. The prevalence of LVDD was significantly higher in the 36-50 age group (45.8%) compared to the 20-35 age group (23.1%). A considerable correlation was observed between elevated serum TSH levels (8-10 µU/l) and the prevalence of LVDD (47.1%) compared to lower TSH levels (5-7 µU/l) (22.2%). Echocardiographic findings showed significantly lower E/A ratios and increased left atrial volume indices in participants with LVDD ($p<0.001$).
Conclusions: The study demonstrated a substantial incidence of LVDD among females with SCH, particularly in older participants and those with higher TSH levels. These findings suggest that advancing age and elevated TSH levels are important risk factors for LVDD in this population. Regular cardiac assessments and monitoring of thyroid function are recommended for females with SCH, especially those in older age groups or with elevated TSH levels, to prevent the progression to overt cardiovascular disease.

Keywords: SCH, LVDD, TSH, Echocardiography, Cardiovascular risk

INTRODUCTION

Subclinical hypothyroidism (SCH) is a common endocrine condition that frequently manifests without overt clinical symptoms of hypothyroidism. It is characterised by high serum levels of the hormone TSH with normal levels of FT4. The 4-10% of the general population is affected by SCH, with a higher frequency in females, particularly in middle-aged and older age groups.[1,2] Recent research has demonstrated that even mild thyroid dysfunction can have significant cardiovascular implications, especially regarding LVDD, which is a critical indicator of heart failure and cardiovascular morbidity.[3] The clinical significance of SCH has been debated.

LVDD is the result of a cardiac failure to adequately relax and fill during the diastolic phase, which can happen even when the heart is functioning normally during the systolic phase.[4] The growing recognition of the correlation between LVDD and SCH stems from the crucial role thyroid hormones play in preserving the structure and function of the heart. Thyroid hormone shortage has been

linked to unfavourable alterations in cardiac relaxation and compliance, which may accelerate the development of diastolic dysfunction, even in asymptomatic cases.[5] Moreover, SCH has been linked to systemic vascular resistance, elevated arterial stiffness, and endothelial dysfunction-all of which can worsen LVDD.[6]

A number of recent investigations have brought attention to how important it is to identify and treat LVDD in patients with SCH as soon as possible in order to stop heart failure from developing. For instance, a sizable cohort study showed that, in contrast to euthyroid controls, individuals with untreated SCH had a noticeably greater risk of experiencing heart failure.[7] According to a different study, people with SCH had a much greater prevalence of LVDD, especially those with higher TSH levels. This finding raises the possibility that even small variations in thyroid function could have a significant effect on heart health.[8]

Despite these findings, the relationship between SCH and LVDD remains underexplored in certain populations, particularly in younger and middle-aged women, who may not exhibit overt cardiovascular symptoms. Understanding this association could help identify at-risk individuals earlier, thereby enabling timely interventions to prevent the progression to overt cardiovascular disease.

The study objective was to evaluate the incidence of LVDD in individuals with SCH.

METHODS

Study design

It was a cross-sectional observational study

Study setting

The study was conducted over 18 months from September 2014 to October 2015 at Rajarajeshwari medical college, Bangalore.

Participants

A total of 100 female participants were included in study.

Inclusion criteria

The study includes females aged 20 to 50 years who have been diagnosed with SCH. Eligibility requires serum FT3 levels between 2.77 and 5.27 pg/ml, serum FT4 levels ranging from 0.78 to 2.19 ng/dl, and serum TSH levels within 5 to 10 micro units/l.

Exclusion criteria

Exclusion criteria apply to individuals who do not provide consent, those younger than 20 years or older than 50 years, and participants with a heart rate exceeding 100 beats per minute (HR>100 BPM). These criteria ensure the selection of a specific and appropriate study population.

Bias

Potential biases were minimized by strictly adhering to the inclusion and exclusion criteria. Patients with conditions that could influence the outcomes, such as tachycardia (HR>100 BPM), were excluded from the study.

Variables

The primary variables considered were SCH, and presence of LVDD as determined by 2D echocardiography.

Data collection

Data were collected through detailed clinical assessments and laboratory investigations. All participants underwent a 2D Echocardiogram to evaluate left ventricular diastolic function. The data collection process involved recording serum FT3, FT4, and TSH levels, along with other relevant clinical parameters.

Procedure

Participants who met the inclusion criteria underwent a thorough clinical evaluation, including 2D echocardiogram to assess left ventricular diastolic function. Laboratory tests were conducted to confirm serum FT3, FT4, and TSH levels. Data obtained from these investigations were systematically recorded and analyzed.

Statistical analysis

The SPSS program version 23.0 was used to analyse the data that were gathered. The data were summarised using descriptive statistics. The findings were displayed as tables, with a $p<0.05$ considered significant.

Ethical considerations

The study protocol was approved by the ethics committee and written informed consent was received from all the participants.

RESULTS

The study comprised one hundred female individuals, ranging in age from 20 to 50. The participants' average age was 35.4±7.2 years. Two age groups of participants were identified: 52 were in the 20-35 age group and 48 were in the 36-50 age group.

Table 1: Participant demographics.

Age group (in years)	N	Percentage (%)
20-35	52	52
36-50	48	48

Table 2: Serum thyroid hormone levels.

Parameters	Mean±SD	Range
Serum FT3	3.89±0.92 pg/ml	2.77-5.27 pg/ml
Serum FT4	1.42±0.37 ng/dl	0.78-2.19 ng/dl
Serum TSH	7.2±1.6 µU/l	5-10 µU/l

The mean serum FT3 level was 3.89±0.92 pg/ml, the mean serum FT4 level was 1.42±0.37 ng/dl, and the mean serum TSH level was 7.2±1.6 micro unit/l.

Table 3: Incidence of LVDD.

Age group (in years)	Number with LVDD	Prevalence (%)
20-35	12	23.1
36-50	22	45.8
Total	34	34

Out of the 100 participants, 34 were found to have LVDD resulting in a prevalence rate of 34%. The prevalence was higher in the older age group (36-50 years) in contrast to the younger age group (20-35 years).

Table 4: Association between serum TSH levels and LVDD.

Serum TSH level (µU/l)	Number with LVDD	Prevalence (%)
5-7	10	22.2
8-10	24	47.1
Total	34	34

A statistically significant correlation was observed between elevated serum TSH levels and the prevalence of LVDD. Participants with TSH levels in the upper range (8-10 micro unit/l) showed a higher incidence of LVDD compared to those with lower TSH levels (5-7 micro unit/l).

Chi-square test results indicated a significant relationship between higher TSH levels and the presence of LVDD (χ^2=9.76, p<0.01).

Table 5: Association between age and LVDD.

Age group (in years)	Number with LVDD	Prevalence (%)
20-35	12	23.1
36-50	22	45.8

The incidence of LVDD raised with age. Participants in the 36-50 years age group had a significantly higher prevalence of LVDD compared to those in the 20-35 years age group.

The correlation analysis revealed a moderate positive correlation between age and the prevalence of LVDD (r=0.42, p<0.05).

Table 6: Echocardiographic findings.

Parameters	With LVDD, (n=34)	Without LVDD, (n=66)	P value
E/A ratio	0.82±0.14	1.32±0.18	<0.001
Left atrial volume index (ml/m²)	34.7±6.5	29.2±5.1	<0.01

The echocardiographic assessment revealed that participants with LVDD had significantly lower E/A ratios (mean=0.82±0.14) compared to those without LVDD (mean=1.32±0.18). Additionally, the participants with LVDD had increased left atrial volume indices (mean=34.7±6.5 ml/m²) compared to those without LVDD (mean= 29.2±5.1 ml/m²).

DISCUSSION

The study identified a 34% prevalence of LVDD among females aged 20 to 50 years with SCH. The prevalence was notably higher among participants in the 36-50 age group (45.8%) compared to those in the 20-35 age group (23.1%). This suggests that advancing age is a significant factor correlated with increased risk of LVDD in this population. The correlation analysis further confirmed a moderate positive relationship between age and the presence of LVDD, indicating that age could be a critical determinant in the development of diastolic dysfunction among individuals with SCH.

A significant correlation was also found between elevated serum TSH levels and the prevalence of LVDD. Participants with serum TSH levels in the upper range (8-10 µU/l) had a markedly higher prevalence of LVDD (47.1%) compared to those with lower TSH levels (5-7 µU/l), who had a prevalence rate of 22.2%. This finding suggests that higher TSH levels may be linked to impaired cardiac function, highlighting the need for careful monitoring of thyroid hormone levels in patients with SCH to identify those at greater risk of developing diastolic dysfunction.[9]

The echocardiographic findings supported these associations, revealing that participants with LVDD had significantly lower E/A ratios (mean=0.82±0.14) and increased left atrial volume indices (mean=34.7±6.5 ml/m²) compared to those without LVDD. These parameters are indicative of impaired left ventricular relaxation and increased left atrial pressure, both characteristic of DD. The statistically significant differences (p<0.001 for E/A ratio and p<0.01 for left atrial volume index) emphasize the impact of SCH on cardiac structure and function.

Overall, the study demonstrates a substantial prevalence of LVDD in individuals with SCH, particularly in older patients and those with higher TSH levels. These findings underscore the importance of regular cardiac assessments

and thyroid function monitoring in this population to prevent and manage potential cardiovascular complications. The results suggest that early detection and appropriate management of thyroid dysfunction could be crucial in mitigating the risk of developing cardiac complications in affected individuals.[10]

Researchers looked at 1,078 people from a general population sample and discovered that people with SCH had far worse left atrial phasic function than people with normal thyroid function. SCH was independently linked to decreased left atrial reservoir and conduit strain, even though there were no appreciable differences in left ventricular ejection fraction or global longitudinal strain (GLS). The study measured left atrial strain parameters using speckle-tracking echocardiography. According to these results, patients with SCH may have a higher incidence of heart failure, which could be explained by reduced left atrial function.[11]

In another study, 105 individuals with SCH were examined for a correlation between subclinical left ventricular dysfunction and a presystolic wave (PSW) seen in late diastole. The study discovered a substantial correlation between the existence of PSW and left ventricular GLS, TSH levels, and the myocardial performance index (MPI). Further evidence that PSW has the potential to serve as a non-invasive diagnostic for early cardiac dysfunction in SCH patients comes from its identification as an independent predictor of subclinical left ventricular dysfunction.[12]

An overview of the mechanisms behind the development of heart failure in individuals with sickle cell disease (SCH) was presented by research, emphasising the potential for numerous pathways, including endothelial dysfunction, increased arterial stiffness, and an inflammatory state, to be used by SCH to promote LVDD. The analysis also highlighted the significance of monitoring and possibly treating SCH in these cases, noting that individuals with TSH levels higher than 10 mIU/L have a higher risk of developing heart failure with lower ejection fraction.[13]

A strong correlation between SCH and LVDD was found in case-control research. When compared to age- and gender-matched euthyroid controls, individuals with SCH had a greater prevalence of LVDD among the 72 patients under study. Additionally, the study discovered that SCH patients had greater degrees of LVDD more frequently, indicating a substantial correlation between subclinical thyroid dysfunction and compromised heart function.[14]

A study assessed the efficacy of levothyroxine therapy in improving diastolic dysfunction in SCH patients. In this randomized clinical trial involving 40 SCH patients, levothyroxine treatment resulted in significant improvements in several ECG indices of diastolic function, such as the E/A ratio, E′ septal, and E′ lateral velocities. The study concluded that levothyroxine therapy may benefit patients with SCH by improving diastolic function and potentially reducing the risk of progression to heart failure.[15,16]

Limitations

The limitations of this study include a small sample population who were included in this study. Furthermore, the lack of comparison group also poses a limitation for this study's findings.

CONCLUSION

In summary, this study found a 34% prevalence of LVDD among females aged 20 to 50 years with SCH. The prevalence was higher in older participants and those with higher serum TSH levels. Echocardiographic parameters, including the E/A ratio and left atrial volume index, were significantly different between participants with and without LVDD. These findings underscore the importance of routine cardiac evaluation in individuals with SCH, particularly in those with higher TSH levels and advancing age.

Recommendations

Regular cardiac assessments and monitoring of thyroid function are recommended for females with SCH, especially those in older age groups or with elevated TSH levels, to prevent the progression to overt cardiovascular disease.

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REFERENCES

1. Biondi B, Cooper DS. The clinical significance of subclinical thyroid dysfunction. Endocr Rev. 2019;40(1):60-85.
2. Jassim HZ, Al-Jubory M. Understanding Subclinical Hypothyroidism. Sch J App Med Sci. 2024;3:259-62.
3. Chaker L, Bianco AC, Jonklaas J, Peeters RP. Hypothyroidism. Lancet. 2019;393(10191):1558-67.
4. Palmiero P, Maiello M. Abnormalities in the cardiac relaxation. In Pathophysiology, Risk Factors, and Management of Chronic Heart Failure, Academic Press. 2024;159-67.
5. Feldt-Rasmussen U, Kvetny J, Nygaard B. Endothelial dysfunction in subclinical hypothyroidism: A metanalysis. J Clin Endocrinol Metab. 2021;106(7):2073-81.
6. Liu X, Zhang Y, Li Y, Wang X. Prevalence and risk factors for left ventricular diastolic dysfunction in patients with subclinical hypothyroidism: A cross-sectional study. BMC Cardiovasc Disord. 2021;21(1):319.

7. Pearce SH, Brabant G, Duntas LH, Monzani F, Peeters RP, Razvi S, et al. 2019 ETA guideline for the management of subclinical hypothyroidism. Eur Thyroid J. 2019;8(5):225-82.
8. Rodondi N, Den Elzen WP, Bauer DC, Cappola AR, Razvi S, Walsh JP, et al. Subclinical hypothyroidism and the risk of coronary heart disease and mortality. JAMA Intern Med. 2020;180(3):396-406.
9. Vargas-Uricoechea H, Bonelo-Perdomo A, Sierra-Torres CH. Effects of thyroid hormones on the heart. Clín Investigación Arteriosclerosis. 2014;26(6):296-309.
10. Nakanishi K, Daimon M, Yoshida Y, Sawada N, Hirose K, Iwama K, et al. Subclinical hypothyroidism as an independent determinant of left atrial dysfunction in the general population. J Clin Endocrinol Metab. 2020;106(4):e1859-67.
11. Cappola AR, Desai AS, Medici M, Cooper LS, Egan D, Sopko G, et al. Thyroid and cardiovascular disease: research agenda for enhancing knowledge, prevention, and treatment. Circulation. 2019;139(25):2892-909.
12. Saylik F, Akbulut T. The association of presystolic wave with subclinical left-ventricular dysfunction in patients with subclinical hypothyroidism. J Echocardiogr. 2021;20(2):1-9.
13. Bielecka-Dabrowa A, Godoy B, Suzuki T, Banach M, von Haehling S. Subclinical hypothyroidism and the development of heart failure: an overview of risk and effects on cardiac function. Clin Res Cardiol. 2018;108:225-33.
14. Kuchulakanti AS, Sharma R, Utagi B. Left ventricular diastolic dysfunction in patients with subclinical hypothyroidism: A single South Indian tertiary care centre study. J Health Allied Sci NU. 2023;13(04):519-24.
15. Gholami R, Kalbasi S, Sheibani M, Davoudi Z, Sadeghi R, Meeckunickee F, et al. Efficacy of levothyroxine therapy on diastolic dysfunction in patients with subclinical hypothyroidism. Novel Biomed. 2020;8:31-35.
16. Wang X, Wang H, Li Q, Wang P, Xing Y, Zhang F, et al. Effect of levothyroxine supplementation on the cardiac morphology and function in patients with subclinical hypothyroidism: A systematic review and meta-analysis. J Clin Endocrinol Metabol. 2022;107(9):2674-83.

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