Original Article

# The thyroid-pericardium connection: Unveiling the influence of hypothyroidism severity on pericardial effusion in South Gujarat's patient population—A cross-sectional study

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## Abstract

**Context:** Hypothyroidism and pericardial effusion are two conditions that are associated with previous research. Nevertheless, the correlation between the severity of hypothyroidism and the occurrence of pericardial effusion remains uncertain. **Aims:** 1. To explore and examine the association between the severity of hypothyroidism and the occurrence of pericardial effusion. 2. To compare clinical characteristics and demographic factors with varying degrees of hypothyroidism severity and pericardial effusion. **Settings and Design:** Tertiary care hospital and cross-sectional study using a pretested, semistructured questionnaire and echocardiography. **Method and Material:** The cross-sectional study encompassed a cohort of 60 patients diagnosed with hypothyroidism. **Statistical Analysis Used:** Epi-info version 7.0 and Open epi version 3.1, Chi-square, mean, and standard deviation were used. **Results:** There were 16 male participants, accounting for 26.7% of the total, and 44 female participants, constituting 73.3% of the cohort. The participants' average age was 35.5 years. Based on TSH levels, the severity of hypothyroidism in the study was classified into three categories: mild (33.4%), moderate (43.3%), and severe (23.3%). The most common symptoms were lethargy, weight gain, and cold intolerance. Also, an association between the severity of hypothyroidism and pericardial effusion was noted. **Conclusion:** This research established a noteworthy correlation between hypothyroidism severity and pericardial effusion incidence that is statistically significant. Nevertheless, no significant associations were detected with demographic factors or pulse rate. These results underscore the significance of monitoring and addressing pericardial effusion in patients with moderate-to-severe hypothyroidism. Further investigations are warranted to extend these findings.

**Keywords:** Echocardiography, hypothyroidism, pericardial effusion, TSH levels

## Introduction

Hypothyroidism is a common condition in which the thyroid gland provides insufficient amounts of thyroid hormone for the needs of peripheral tissues.[1] It is categorized into mild, moderate, and severe based on thyroid-stimulating hormone (TSH) levels.[2] Thyroid hormones, crucial for metabolism and cardiovascular function, influence heart rate, contractility, vascular tone, and

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endothelial function. Alterations in thyroid hormone levels can significantly impact the cardiovascular system.[3]

Pericardial effusion (PE) refers to abnormal fluid accumulation within the pericardial sac, which surrounds the heart. PE can range from mild to severe, potentially leading to life-threatening complications such as cardiac tamponade.[4] Studies have indicated a higher occurrence of pericardial effusion (PE) in individuals with hypothyroidism when compared with the general population.[5]

The primary objective of this study is to explore and examine the association between the severity of hypothyroidism and the occurrence of pericardial effusion. Furthermore, the study aims to compare patients' clinical characteristics and demographic factors with varying degrees of hypothyroidism severity and pericardial effusion. This will be an important study in family practice to prevent morbidity and mortality associated with the severity of hypothyroidism.

## Subjects and Methods

This cross-sectional observational study took place in a tertiary healthcare hospital located in South Gujarat.

The duration of the study was from September 2018 to August 2020.

This study includes hypothyroid patients: those who have recently been diagnosed with hypothyroidism and those who have not received any previous treatment.

The study excluded patients with secondary hypothyroidism, a history of thyroid illness or surgery, abnormal renal or liver function tests, significant usage of medications affecting thyroid function, pregnancy, and comorbidities such as hypertension, diabetes mellitus, known previous heart disease, other endocrine disorders, and collagen disorders.

Sample size calculation: According to reports, 3% of people have hypothyroidism combined with pericardial effusion.[6] The sample size was calculated using the formula 4pq/L2 with a 5% acceptable error and a 95% confidence level based on this prevalence. Using 5% as the prevalence ($P$ = 0.03) and q = 1-p = 0.97, the sample size is 45, which is {4*0.03*0.97}/0.052. The final sample size was 55 when 20% of nonresponders were included.

A total of 60 patients who fulfilled the inclusion criteria were recruited during the data collection period, resulting in a final sample size of 60 participants.

### Methods of data collection

The data collection methods used in the study involved obtaining written consent from eligible patients who met the inclusion criteria before their participation. A pretested, semistructured questionnaire was used to collect sociodemographic information. In addition, relevant investigations, such as TSH level assessment and evaluation of pericardial effusion using echocardiography, were conducted as part of the data collection process.

**Sample Size for Frequency in a Population**

| | |
|---|---|
| Population size(for finite population correction factor or fpc)(*N*): | 7000000 |
| Hypothesized % frequency of outcome factor in the population (*p*): | 3%+/-5 |
| Confidence limits as % of 100(absolute +/- %)(*d*): | 5% |
| Design effect (for cluster surveys-*DEFF*): | 1 |

**Sample Size(*n*) for Various Confidence Levels**

| ConfidenceLevel(%) | Sample Size |
|---|---|
| 95% | 45 |
| 80% | 20 |
| 90% | 32 |
| 97% | 55 |
| 99% | 78 |
| 99.9% | 127 |
| 99.99% | 177 |

Equation

Sample size $n = [DEFF*Np(1-p)]/ [(d^2/Z^2_{1-\alpha/2}*(N-1)+p*(1-p)]$

Results from OpenEpi, Version 3, open source calculator--SSPropor
Print from the browser with ctrl-P
or select text to copy and paste to other programs.

### Statistical analysis

Epi-info version 7.0 and Open epi version 3.1 were used for statistical analysis after entering the gathered data into Microsoft Excel version 16.0. All normally distributed data were subjected to univariate and bivariate analysis, with the findings shown as mean and standard deviation. These data were subjected to parametric testing. Nonparametric tests, such as the Chi-square test, were used for categorical data. Statistical significance was defined as a $P$ value of less than 0.05, suggesting a significant association or difference between the variables under comparison.

## Results

Patients with hypothyroidism were chosen from a tertiary healthcare hospital in South Gujarat for a cross-sectional study. The study's main goal was to find any possible connections between these patients' hypothyroidism and pericardial effusion. The study involved 60 hypothyroid individuals who were all eager to participate and who fulfilled the study's eligibility requirements. A total of 60 hypothyroid individuals were enrolled in the study, with 16 (26.7%) men and 44 (73.3%) women. The patients' average ages were 35.5 years, on average, with a standard deviation of 9.39 years. Male patients' mean age was 38 years, with a standard deviation of 10, whereas female patients' mean age was 34.6 with a standard deviation of 9.11 years.

The largest age group was 31-40 years, comprising 26 individuals (43.33%). Within this age range, there were 6 males (37.5%) and 20 females (45.45%). The second largest age group was the third decade (21-30 years), which accounted for 20 individuals (33.33%). Among this age range, there were 4 males (20%) and 16 females (80%). The 41-50 years' age range

included 8 individuals (13.33%), with an equal male-to-female ratio of 1:1. Finally, the age range of 51-60 years comprised 6 individuals, accounting for 10% of the total sample. Among these individuals, the female-to-male ratio was 2:1 [Table 1].

The severity of hypothyroidism in a sample of 60 patients was classified based on their thyroid-stimulating hormone (TSH) levels. The classification consisted of three categories: mild, moderate, and severe. In the mild category, there were 20 patients (33.4%) with TSH levels ranging from 0.5 to 20 mU/L. The moderate category included 26 patients (43.3%) with TSH levels ranging from 20 to 50 mU/L. The severe category comprised 14 patients (23.3%) with TSH levels exceeding 50 mU/L. These data provide valuable insights into the prevalence of mild, moderate, and severe cases within the sample population [Table 2].

The symptoms reported by a group of 60 patients diagnosed with hypothyroidism reveal that lethargy was experienced by 66.6% of the patients. Hoarseness was reported by 53.3% of the patients. Among the patients, 30% reported dyspnea, reflecting difficulty or discomfort in breathing. Weight gain was a notable symptom, affecting 73.3% of the patients. Similarly, 50% of the patients experienced cold intolerance. Depression symptoms were evident in 26.6% of the patients in the study. Dry skin was a prevalent symptom, reported by 63.3% of the patients. Finally, menstrual symptoms were reported by 59.1% of female patients [Figure 1].

The general examination findings unveil several notable observations. First, 26.66% of the patients exhibited pallor. Dry skin was another prevalent finding, with 63.33% of the patients experiencing this symptom. A considerable proportion of patients (76.66%) had a body mass index (BMI) above 25 kg/m$^2$, indicating that they were either overweight or obese. A smaller percentage (10%) of patients displayed signs of goiter, an enlargement of the thyroid gland located in the neck. Edema was observed in 20% of the patients. In terms of vital signs, 30% of the patients exhibited a pulse rate below 60 beats per minute, suggesting bradycardia or a slower-than-normal heart rate. Regarding blood pressure, 76.66% of the patients had readings within the range of 120/80 to 140/90 mmHg, which is considered normal or prehypertensive. However, 23.33% of the patients had blood pressure readings above 140/90 mmHg, indicating hypertension or high blood pressure [Figure 2].

Furthermore, when considering the association of sex, body mass index (BMI), and pulse rate with pericardial effusion, the study included 60 participants, of which 44 (73.3%) were female and 16 (26.7%) were male. Among females, the highest proportion of patients without pericardial effusion (PE) was observed, with 31 (77.5%) of 40 patients. In the mild PE category, 7 (70%) of 10 patients were females. Similarly, in the moderate PE category, 5 (62.5%) of 8 patients were females. However, in the severe PE category, the proportion was slightly lower among females, with 1 (50%) of 2 patients. Among males, 9 (22.5%) of 40 patients had no PE, whereas 3 (30%) of 10 patients had mild PE. In the moderate PE category, 3 (37.5%) of 8 patients were males. Interestingly, in the severe PE category, the proportion was the same as females, with 1 (50%) of 2 patients. Overall, no statistically significant association was found between sex and the severity of pericardial effusion (*P* value = 0.694), indicating that the distribution of PE severity did not significantly differ between males and females in the studied population. ($\chi$2: 1.45, DF = 03, *P* = 0.694).

Regarding BMI, of the total 60 patients, 14 (23.3%) had a BMI less than 25, whereas 46 (76.7%) had a BMI greater than 25. Among those with a BMI greater than 25, the highest proportion of patients without PE was observed, with 29 (72.5%) of 40 patients. In the mild pericardial effusion (PE) category, 9 of 10 patients (90%) had a BMI greater than 25. Similarly, in the moderate PE category, 6 of 8 patients (75%) had a BMI greater than 25. In the severe PE category, both patients (100%) had a BMI greater than 25. Among patients with a BMI less than 25, 11 of 40 (27.5%) had no pericardial effusion (PE), and 1

**Table 1: The age and sex patterns in hypothyroidism patients (Number = 60)**

| Age (years) | Male *n* (%) | Female *n* (%) | Total *n* (%) |
|---|---|---|---|
| 21-30 | 4 (25) | 16 (36.4) | 20 (33.3) |
| 31-40 | 6 (37.5) | 20 (45.4) | 26 (43.4) |
| 41-50 | 4 (25) | 04 (9.1) | 08 (13.3) |
| 51-60 | 2 (12.5) | 04 (9.1) | 06 (10) |
| Total | 16 (100) | 44 (100) | 60 (100) |
| Mean±SD | 38.0±10 | 34.6±9.11 | 35.5±9.39 |

**Table 2: Distribution of patients according to thyroid-stimulating hormone (TSH) level (*n*=60)**

| Severity of hypothyroidism | TSH levels (mU/L) *n* (%) | No. of patients *n* (%) |
|---|---|---|
| Mild | 0.5-20 | 20 (33.3) |
| Moderate | 20-50 | 26 (43.4) |
| Severe | >50 | 14 (23.3) |
| Total | | 60 (100) |

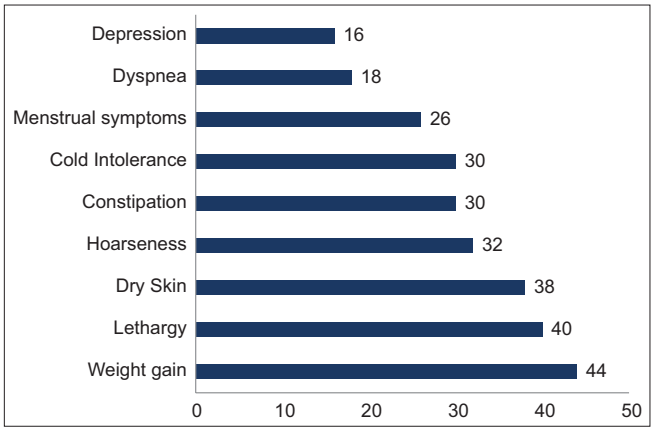


**Figure 1:** Distribution of symptoms presented by hypothyroidism patients (n = 60)

of 10 (10%) had mild PE. In the moderate PE category, 2 of 8 patients (25%) had a BMI less than 25. Notably, there were no patients with a BMI less than 25 found in the severe PE category. However, based on the Fisher exact test results, there was no statistically significant association between BMI and the severity of pericardial effusion (*P* value = 0.571). This suggests that the distribution of pericardial effusion severity did not significantly differ between patients with a BMI less than 25 and those with a BMI greater than 25 in the studied population ($\chi$2: 2.003, DF = 03, *P* = 0.571).

Regarding pulse rate, of the total 60 patients, 24 (40%) had a pulse rate below 60 beats per minute, whereas 36 (60%) had a pulse rate above 60 beats per minute. Among those with a pulse rate above 60, the highest proportion of patients without pericardial effusion (PE) was observed, with 27 (67.5%) of 40 patients. In the mild PE category, 6 (60%) of 10 patients had a pulse rate above 60. In the moderate PE category, 3 (37.5%) of 8 patients had a pulse rate above 60. Notably, there were no patients with a pulse rate above 60 found in the severe pericardial effusion (PE) category. Among patients with a pulse rate below 60, 13 of 40 (32.5%) had no PE, and 4 of 10 (40%) had mild PE. In the moderate PE category, 5 (62.5%) of 8 patients had a pulse rate below 60. In the severe PE category, 2 (100%) of 2 patients had a pulse rate below 60. Based on the Fisher exact test results, the obtained *P* value of 0.131 indicates that there is no statistically significant association between pulse rate and the severity of pericardial effusion. This means that the distribution of pericardial effusion (PE) severity did not significantly differ between patients with a pulse rate below 60 and those with a pulse rate above 60 in the studied population. In other words, the pulse rate was not found to be statistically associated with the severity of pericardial effusion in this particular group of patients ($\chi$2: 5.625, DF = 03, *P* = 0.131) [Table 3].

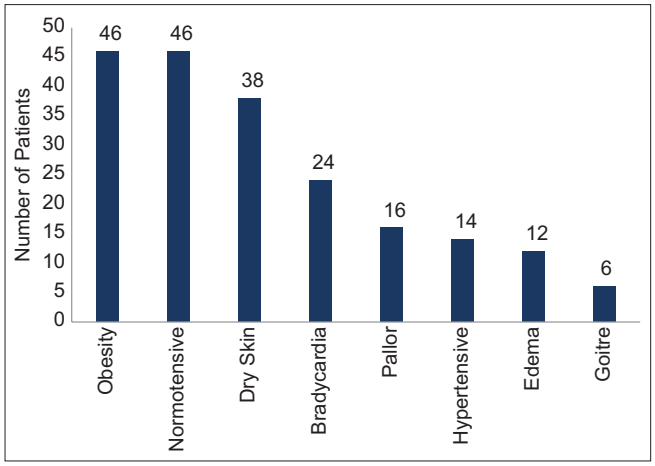


**Figure 2:** General examination findings about hypothyroidism patients (n = 60)

## Discussion

Hypothyroidism is a medical condition characterized by an underactive thyroid gland, which results in reduced production of thyroid hormones, such as thyroxine (T4) and triiodothyronine (T3). A decrease in thyroid hormone levels can lead to a range of symptoms and health issues. It can result in various symptoms such as fatigue, weight gain, and depression. Thyroid disorder is one of the most common endocrine disorders encountered in family practice.

Pericardial effusion, on the other hand, refers to the accumulation of fluid in the sac surrounding the heart, known as the pericardium. It can be caused by various factors, including inflammation, infection, or underlying medical conditions. The association between hypothyroidism and pericardial effusion is of interest because of the potential impact of thyroid hormone deficiency on cardiac function and fluid regulation.

**Table 3: Association of health profile with cardiac functions in patients with hypothyroidism (*n*=60)***

| Variables | No PE‡ *n* (%) | Mild PE *n* (%) | Moderate PE *n* (%) | Severe PE *n* (%) | Total *n* (%) | *P* |
|---|---|---|---|---|---|---|
| Sex | | | | | | |
| Female | 31 (77.5) | 7 (70) | 5 (62.5) | 1 (50) | 44 (73.3) | 0.694 |
| Male | 9 (22.5) | 3 (30) | 3 (37.5) | 1 (50) | 16 (26.7) | |
| Total *n* (%) | 40 (66.7) | 10 (16.7) | 8 (13.3) | 2 (3.3) | 60 (100) | |
| BMI± (kg/m²) | | | | | | |
| <25 | 11 (27.5) | 1 (10) | 2 (25) | 0 (0) | 14 (23.3) | 0.572 |
| >25 | 29 (72.5) | 9 (90) | 6 (75) | 2 (100) | 46 (76.7) | |
| Total *n* (%) | 40 (66.7) | 10 (16.7) | 8 (13.3) | 2 (3.3) | 60 (100) | |
| Pulse (per minute) | | | | | | |
| <60 | 13 (32.5) | 4 (40) | 5 (62.5) | 2 (100) | 24 (40) | 0.131 |
| >60 | 27 (67.5) | 6 (60) | 3 (37.5) | 0 (0) | 36 | |
| Total *n* (%) | 40 (66.7) | 10 (16.7) | 8 (13.3) | 2 (3.3) | 60 (100) | |
| Hypothyroidism | | | | | | |
| Mild | 18 (90) | 2 (14.3) | 0 (0) | 0 (0) | 20 (33.3) | 0.01 |
| Moderate | 16 (61.5) | 6 (23.0) | 4 (15.4) | 0 (0) | 26 (43.3) | |
| Severe | 6 (48.9) | 2 (14.3) | 4 (28.6) | 2 (14.3) | 14 (23.4) | |
| Total *n* (%) | 40 (66.7) | 10 (16.7) | 8 (13.3) | 2 (3.3) | 60 (100) | |

*Number, ‡Pericardial effusion, ±Basal metabolic rate

Understanding this relationship is important for the diagnosis, management, and monitoring of patients with hypothyroidism.

Although these conditions may seem unrelated at first glance, there can be a correlation between them. The thyroid gland plays a vital role in the regulation of numerous bodily functions, including heart rate, blood pressure, and metabolism. The hormones produced by the thyroid gland, primarily thyroxine (T4) and triiodothyronine (T3), influence the rate at which the body's cells produce energy from nutrients, affecting overall metabolism. Thyroid hormones also have a direct impact on the heart, helping to regulate heart rate and rhythm, and they can influence blood pressure by affecting blood vessel dilation and constriction. Thus, any imbalance in thyroid hormone levels, as seen in conditions such as hypothyroidism or hyperthyroidism, can significantly impact these essential bodily functions and result in various health issues. Therefore, any disruption in thyroid hormone levels can have an impact on cardiovascular health. This study is important to decrease morbidity in patients managed by primary care physicians.

This cross-sectional study collected information from 60 patients having hypothyroidism over one year. The data analyzed to study descriptive statistics, which showed that the female-to-male ratio for these admitted cases was around 3 (2.7):1. A cross-sectional study conducted by Ambika Unnikrishnan *et al.*[7] in 8 major cities of India reported that the female-to-male ratio was 2:1. A study conducted by Chiovato *et al.*[8] revealed that primary hypothyroidism is up to 8–9 times more common in women than in men, and the prevalence increases with age.

The findings from the cross-sectional study conducted by Alireza Khabbazi *et al.*[9] at Tabriz University revealed that among patients with hypothyroidism, 44.7% reported experiencing cold-related symptoms, whereas 11.1% reported cold intolerance. Meanwhile, this study revealed that 50% of individuals experienced cold intolerance.

Furthermore, these results suggest a discrepancy between the overall prevalence of cold intolerance and its occurrence specifically among hypothyroidism patients. One possible explanation for this disparity could be attributed to variations in geographical location. In addition, it is worth noting that the study used telephonic interviews in that study as a method of data collection, which may have introduced some limitations in the accuracy of the reported results.

This study shows that weight gain and dry skin were found in 76.6% and 63.3% of patients, respectively. A similar cross-sectional study performed by Caroline S. Fox *et al.*[10] found that the prevalence of obesity at baseline was 14.3%. The cross-sectional study conducted by Reshma A. Esmail *et al.*,[11] in the USA, demonstrated that the mean waist-to-hip ratio is significantly higher in patients with hypothyroidism compared with patients with euthyroid status.

Goiter was found in 6 patients in this study. The cross-sectional study conducted by Sharath Kumar D. Shah *et al.* showed 3% of cases of goiter, and these findings coincide with this study's findings.[12] This diversity in the result might be due to the large and diverse sample of this study which gives nonidentical findings.

The study conducted by Dalal Marji Alruwaili and Alanazi[13] in Saudi Arabia documented that among adult patients receiving treatment for hypothyroidism, the prevalence of depression was found to be 56.1%. By contrast, the current study observed that depression symptoms were prevalent in 26.6% of the patients. These findings indicate a notable difference in the prevalence of depression among individuals with hypothyroidism between the two studies. The discrepancy in the findings of the two studies regarding the prevalence of depression among individuals with hypothyroidism may be attributed to differences in the samples used or variations in the duration of the studies. These factors could have influenced the results and contributed to the disparity observed.

The present study revealed that 30% of individuals experienced dyspnea, whereas a study conducted by V Gurudatta Murthy *et al.* in Bangalore reported that 50% of patients exhibited symptoms of dyspnea.[14] Notably, the findings of the latter study closely align with our results. This coincidence suggests that the similarity in the prevalence of dyspnea between the two studies could be attributed to a comparable number of participants in the sampled population.

In the study conducted by C. A. Hardisty *et al.*[15] at Sheffield, echocardiography was performed on hypothyroidism patients to assess the presence of pericardial effusion. The results showed that pericardial effusion was present in twelve patients, accounting for approximately 30% of the cases. This finding coincides with our study's findings, which observed that approximately 40% of the cases in our study exhibited normal findings on the echo examination, whereas pericardial effusion was the next most common finding, observed in sixteen cases, which corresponds to around 26.7% of the cases. This indicates that hypothyroidism has an impact on heart activity.

In contrast to the previously mentioned findings, the study conducted by Udaya M. Kabadi and Kumar[16] reported that only two of 30 patients exhibited pericardial effusion on echo findings. One possible explanation for this discrepancy could be the difference in the age of the populations studied. It is worth noting that most subjects in that particular study were significantly older, with an age group of over 65 years. Indeed, the variation in age distribution between the two studies can be a significant contributing factor to the difference in the prevalence of pericardial effusion observed.

The study conducted by R. Verma reported a prevalence of effusion at 45%.[17] Pericardial effusion is known to occur in 30% to 80% of patients with hypothyroidism, as mentioned in a publication by Rawat and Satyal,[18] the relatively lower incidence of pericardial effusion may be attributed to the selection of new hypothyroid cases.

## Limitations

One limitation of this study is its cross-sectional design, which only provides a snapshot of the relationship between hypothyroidism and pericardial effusion at a single point in time. Longitudinal studies would be necessary to establish a cause-and-effect relationship and determine the temporal sequence of events. In addition, the study population was limited to patients from a specific tertiary healthcare hospital in South Gujarat, which may restrict the generalizability of the findings to other populations or settings. Further research involving larger and more diverse populations is crucial to validate and build upon the findings of the cross-sectional study.

## Recommendations

1. Public level:
    - Educate the public about hypothyroidism symptoms and the importance of regular check-ups.
    - Encourage exercise and balanced diets to manage weight gain associated with hypothyroidism.
2. Community level:
    - Collaborate with healthcare providers to offer regular hypothyroidism screenings, targeting high-risk groups.
    - Organize workshops and community talks to raise awareness about hypothyroidism and early detection.
3. Policy-maker level:
    - Establish comprehensive guidelines for hypothyroidism diagnosis, treatment, and pericardial effusion monitoring.
    - Encourage further research on the relationship between hypothyroidism and pericardial effusion.
    - Push for policies covering hypothyroidism diagnosis, treatment, and management.

Implementing these recommendations will improve early detection, management, and outcomes for hypothyroidism, including pericardial effusion. Collaboration between the public, community, and policy-making sectors is crucial for comprehensive care and addressing the challenges associated with hypothyroidism.

## Ethical policy and institutional review board statement

The study has been approved by the Human Research Ethical Committee (HREC) of the Government Medical College, Surat, Gujarat, India with Ref. No.: GMCS/6116/EC- Protocol No. 163/2019 Dated-24/06/2019.

## List of abbreviations

| Abbreviation | Definition |
|---|---|
| N | Number |
| PE | Pericardial effusion |
| BMI | Body mass index |
| TSH | Thyroid-stimulating hormone |

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Nil.

## Conflicts of interest

There are no conflicts of interest.

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