ISSN: 0250-6882

Volume 5

EMA
جمعية الإمارات الطبية
EMIRATES MEDICAL ASSOCIATION

NEW EMIRATES MEDICAL JOURNAL

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Emirates Med J 2024; 5: e02506882363676

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CASE REPORT

A Case Report of Severe Hypothyroidism-induced Cardiomyopathy and Anemia: The Concealed Cause

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Abstract:

Background:

Cardiomyopathies are a broad range of cardiac illnesses defined by mechanical and/or electrical dysfunction and abnormal ventricular hypertrophy or dilatation. Cardiomyopathies are classified into two categories: either primarily related to myocardial disease or secondary to other systemic or organ disorders, including the thyroid gland. Thyroid hormones have been linked to a wide range of significant effects on the cardiovascular system.

Case Presentation:

We experienced a case of a 37-year-old male who presented with symptoms of heart failure and was discovered to have dilated cardiomyopathy. The echocardiography study revealed significant left ventricular global hypokinesia and severely depressed left ventricular systolic function. The laboratory testing confirms the presence of severe normocytic, normochromic anemia with severe hypothyroidism.

Conclusion:

The present case illustrates that hypothyroidism should be addressed systematically by healthcare providers when dilated cardiomyopathy is identified, and thyroid function testing should be regularly performed.

Keywords: Heart failure, Dilated cardiomyopathy, Hypothyroidism, Thyroid gland disorder, Anemia, Cardiomyopathies.

Article History	Received: October 11, 2024	Revised: November 15, 2024	Accepted: November 20, 2024

1. INTRODUCTION

Cardiomyopathies are a diverse set of myocardial disorders characterized by mechanical and/or electrical dysfunction and improper ventricular hypertrophy or dilatation [1]. Cardiomyopathies can be grouped into two types: primary (myocardium) and secondary to other systemic or organ diseases. Primary cardiomyopathy could be due to genetic hereditary causes (*e.g.*, mitochondrial myopathies), acquired factors (*e.g.*, inflammatory cardiomyopathies), or a mixture of causes like dilated and restrictive cardiomyopathies [1, 2]. Infiltrative cardiomyopathy (such as amyloidosis), drug and heavy metal toxicity, inflammatory cardiomyopathy (like sarcoidosis), endocrine disorders (in the case of thyroid gland disease), and autoimmune diseases (*e.g.*, scleroderma) are examples of secondary causes of cardiomyopathy [1, 2]. Thyroid hormone has an enormous impact on the cardiac and vascular systems. Cardiometabolic alterations and endothelial dysfunction due to decreased availability of nitric oxide, systolic and diastolic left ventricular dysfunction, disruptions in heart rhythm, and bradycardias are all frequent effects of thyroid disease on the cardiovascular system [3, 4].

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2. CASE REPORT

This is a 37-year-old male with no significant past medical history. He presented to our center with complaints of exertional shortness of breath, dyspnea, and cold intolerance for four to five months. Ten days before the admission, he started to feel fatigue, body aches, generalized weakness, malaise, and increasing dyspnea associated with orthopnea. He denied a history of chest pain or fever. He was not a smoker or alcohol consumer.

Initial vital signs revealed a blood pressure of 74/49 mmHg, a pulse rate of 94 beats per minute, a temperature of 35.6 °C, a respiratory rate of 18 breaths per minute, and an oxygen saturation level of 86% on room air. On examination,

the patient was conscious but drowsy, pale, tachypneic, and had cold extremities. Physical examinations showed bilateral crackles in both lungs and a gallop rhythm heard on heart examinations.

Resting electrocardiogram (ECG) showed sinus rhythm, low QRS voltage, and non-specific ST-T changes in inferolateral leads (Fig. **1**).

Laboratory tests indicated a white blood cell (WBC) count of 7.6 10^3/uL, a red blood cell (RBC) count of 2.30 10^6/uL, a hemoglobin of 6.5 g/dL, a hematocrit of 19.8%, a mean corpuscular volume (MCV) of 85.9 fL, mean corpuscular hemoglobin (MCH) of 28.4 pg, and a red blood cell distribution width (RDW) of 17.8%. Blood film examination revealed normochromic RBCs with anisopoikilocytosis, suggestive of severe normochromic anemia. Absolute retic count (61.6 10^9/L) and platelet count (256 10^3/uL) were normal. Normal serum iron (72 ug/dL), iron saturation (25%), folic acid (14.3 ng/mL), and vitamin B12 (553 pg/mL) levels. Erythrocyte sedimentation rate (ESR) of 119 mm/1hr (normal range: <11 mm/1hr).

Serum sodium of 124 mmol/L, serum potassium of 4.2 mmol/L, serum bicarbonate of 17.2 mmol/L, lactic acid of 10.0 mmol/L, serum urea of 26 mg/dL, serum creatinine of 1.2 mg/dL, and N-terminal pro-B-type natriuretic peptide (NT-proBNP) of 14,467 pg/mL (normal range: <125 pg/mL). Fasting lipid profile demonstrated a total cholesterol of 253 mg/dL, a low-density lipoprotein (LDL) of 186 mg/dL, a high-density lipoprotein (HDL) of 24 mg/dL, and a triglyceride of 126 mg/dL. Serum angiotensin-converting enzyme level was normal (12 U/l).

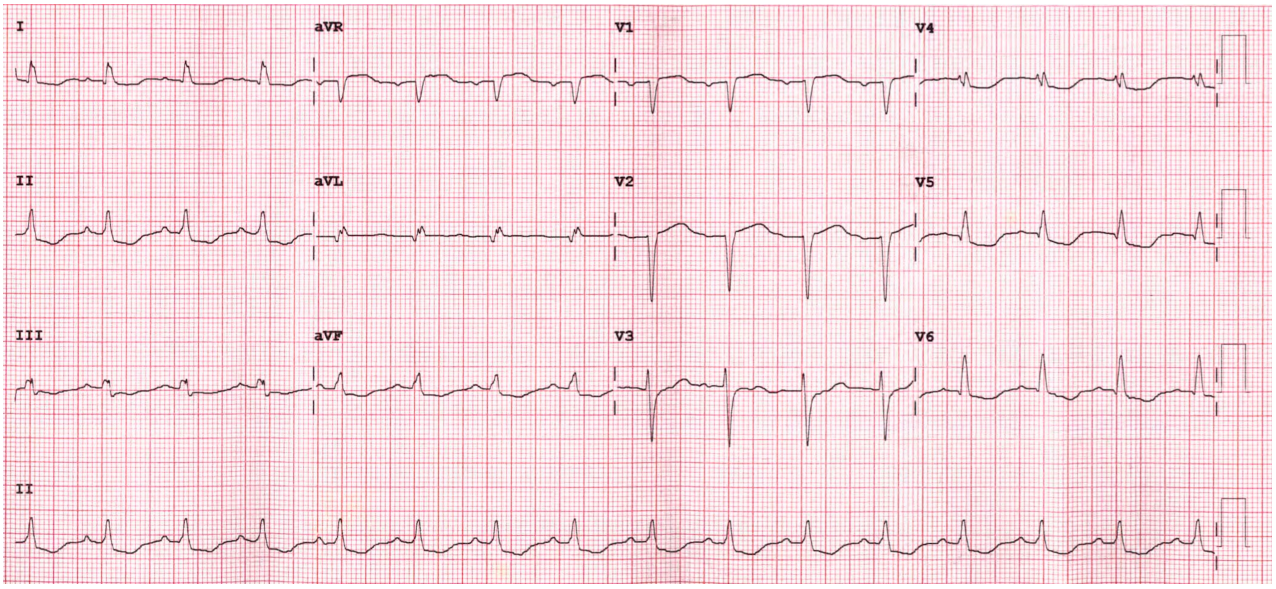

Fig. (1). Resting ECG on admission shows sinus rhythm at a rate of 93 beats/minute, low QRS complex voltage, and non-specific ST-T changes in inferolateral leads. QRS duration of 110 milliseconds, QT corrected of 488 milliseconds and normal QRS axis.

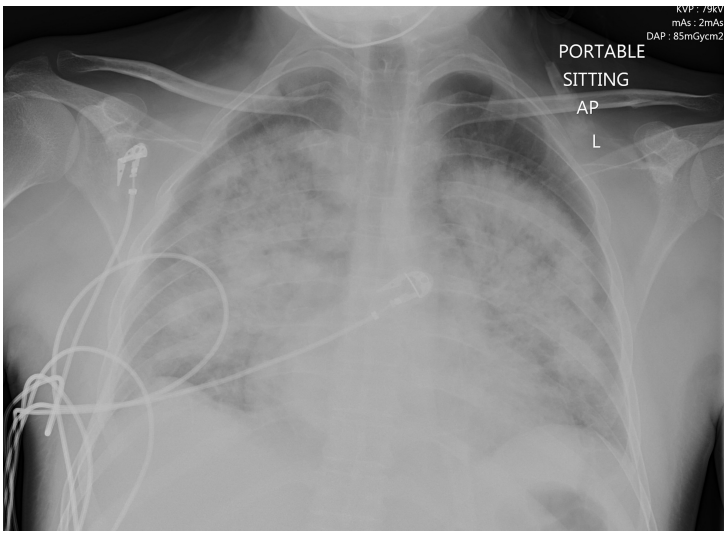

Fig. (2). A portable chest X-ray demonstrates bilateral lung fields with patchy opacities suggestive of acute pulmonary edema.

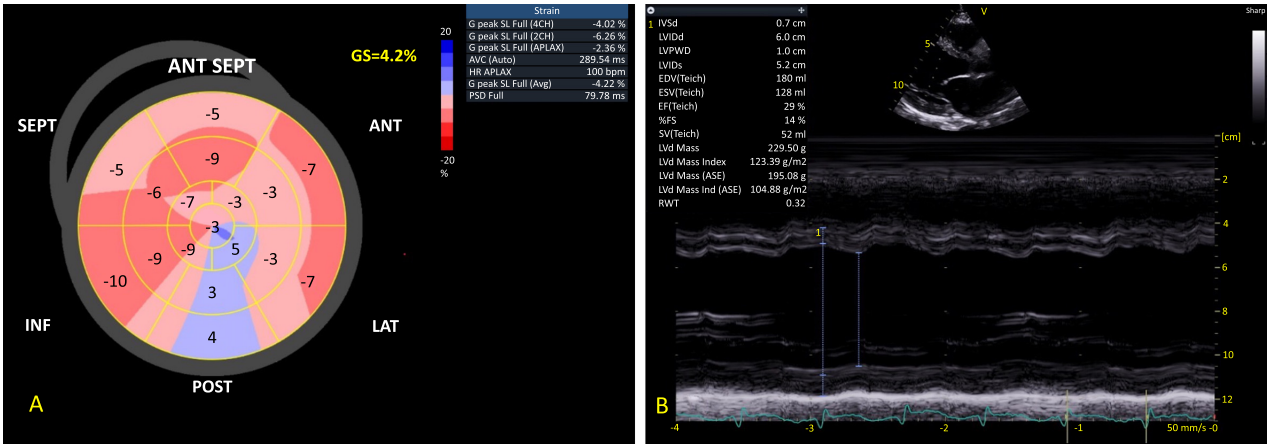

Fig. (3). A, depicts a longitudinal strain bull's-eye plot with a considerably diminished average global strain (GS) of -4.2%, indicating substantially impaired left ventricular (LV) systolic function. **B**, M-mode diagram illustrates dilated LV with depressed LV ejection fraction.

Hormonal testing showed a low free thyroxine level (3.5 pmol/L) and a very high thyroid-stimulating hormone (TSH) level of >100.0 uIU/mL (normal range: 0.27 - 4.2 uIU/mL), suggestive of severe hypothyroidism. Normal dynamic cortisol level (523 nmol/L).

Autoimmune testing showed a normal level of anti-gastric parietal cell antibodies (<2.0 RU/ml), anti-nuclear antibodies (negative <1/100), double-stranded DNA antibodies (<10 IU/ml), anti-tissue transglutaminase IgA (<1.90 IU/ml), anti-tissue transglutaminase IgG (<3.80 IU/ml), rheumatoid factor (<10 IU/mL), and a low level of thyroid peroxidase antibody (19.0 IU/mL).

Chest X-ray showed bilateral increased broncho-vascular markings with central peri-bronchial patchy opacities likely denoting cardiopulmonary congestion with pulmonary edema (Fig **2**).

A transthoracic echocardiogram study demonstrated a mildly dilated left ventricle (LV). There was severe global hypokinesis of LV contractility with severely impaired LV systolic function with an ejection fraction between 20% and 25%. The diastolic function study indicated a restrictive LV filling pattern, consistent with elevated left atrial pressure. Moderate mitral regurgitation was present (Fig **3**).

The patient was resuscitated with inotrope and vasopressor infusion along with loop diuretics. He required high-dose oxygen therapy, which was delivered through a noninvasive ventilator and a high-flow nasal cannula (up to 50 L/minute with a fraction of inspired oxygen of 80%) to maintain acceptable arterial blood gas parameters. Due to severe anemia, he was transfused with two units of packed RBC. He was reviewed by the endocrinologist, and levothyroxine therapy was initiated in small doses initially and then was up-titrated gradually up to 125 µg daily. Heart failure medication was gradually initiated in the form of a beta-blocker, furosemide, and renin-angiotensin-aldosterone system (RAAS) blocker. He made a proper but gradual recovery, and he was discharged home with anti-heart failure and levothyroxine therapy.

3. DISCUSSION

Hypothyroidism, characterized by insufficient thyroid hormone production, can have profound effects on multiple organ systems, particularly the cardiovascular system. Thyroid hormones are crucial for maintaining normal cardiovascular function. They play an essential role in regulating heart rate, blood pressure, myocardial contractility, vascular resistance, and overall cardiac output [3, 5]. Their deficiency can lead to several cardiac issues. One of the rarest and least recognized but significant cardiac manifestations of hypothyroidism is cardiomyopathy. Decreased levels of thyroid hormones lead to reduced myocardial contractility and impaired systolic and diastolic function. They directly influence the expression of genes involved in cardiac function, a decrease in the expression of β-adrenergic receptors, calcium handling in the cardiomyocytes, the activity of various ion channels, and the metabolism of lipids, all of which are vital for maintaining cardiovascular health [6].

Prolonged and untreated hypothyroidism can lead to dilated cardiomyopathy, characterized by ventricular dilation and impaired systolic function. This condition results from the direct effects of low thyroid hormone on cardiac muscle cells, leading to myocardial degeneration and fibrosis, a condition characterized by the excessive deposition of collagen in the myocytes [5, 7, 8].

Hypothyroidism increases systemic vascular resistance, primarily due to decreased endothelial production of vasodilators like nitric oxide (endothelial dysfunction), contributing to left ventricular hypertrophy and, eventually cardiomyopathy and heart failure [5, 9].

Hypothyroidism leads to decreased metabolic rate, altered lipid metabolism, and impaired cardiac contractility. This can result in bradycardia, elevated cholesterol levels (low-density lipoprotein), and increased risk of atherosclerosis. Dyslipidemia can accelerate the development of atherosclerosis, further compromising cardiac function and contributing to ischemic cardiomyopathy [10 - 12].

The relationship between hypothyroidism and anemia is

well documented. Thyroid hormones play a crucial role in erythropoiesis. When thyroid hormone levels are decreased, erythropoiesis is impaired, leading to anemia [13]. Anemia in the context of hypothyroidism can be multifactorial, involving several mechanisms related to the effects of thyroid hormone deficiency on hematopoiesis and erythropoiesis. Several forms of anemia can be associated with hypothyroidism.

Normocytic normochromic anemia is the most common form of anemia seen in hypothyroid patients. The underlying mechanism is believed to be a direct result of decreased erythropoiesis due to insufficient thyroid hormone levels [14].

Hypothyroidism can also be associated with macrocytic anemia. It is often linked to vitamin B12 or folate deficiency, both of which are more prevalent in hypothyroid patients. The impaired absorption of these vitamins, particularly in the context of autoimmune thyroiditis, can be the primary cause. Autoimmune thyroiditis can also affect red blood cell lifespan and contribute to anemia [15].

Although less common, hypothyroidism can be associated with iron deficiency anemia. Hypothyroid patients may have reduced gastric acidity, which impairs iron absorption. Additionally, menstrual irregularities in women with hypothyroidism can lead to increased blood loss, contributing to iron deficiency [14, 15].

Diagnosing hypothyroidism-induced cardiomyopathy involves a combination of clinical evaluation, laboratory testing, and imaging studies. It can be challenging, as these symptoms can overlap with other forms of heart failure. Recognizing the cardiovascular manifestations of hypothyroidism is necessary for early diagnosis and prevention of irreversible cardiac damage. This includes monitoring for signs such as bradycardia, low voltage on the ECG, and symptoms of heart failure [16 - 18].

The cornerstone of managing hypothyroidism-related cardiomyopathy is thyroid hormone replacement therapy, typically with levothyroxine. This treatment can lead to significant improvements in cardiac function and overall prognosis if initiated early [17, 18]. However, it is fundamental to initiate treatment cautiously, particularly in patients with longstanding hypothyroidism or severe cardiomyopathy, as sudden increases in thyroid hormone levels can exacerbate myocardial ischemia or trigger arrhythmias [17].

Treatment with levothyroxine in those with overt thyroid dysfunction has been shown to improve low-density lipoprotein cholesterol, total cholesterol, triglycerides, hypertension, diastolic dysfunction, heart rate, and heart rate variability in exercise and to delay the progression of atherosclerosis [3]. Authors have shown that with effective treatment, left ventricular function can improve and symptoms of heart failure can be alleviated, underscoring the importance of early diagnosis and intervention [19]. Even in patients with clinical or subclinical hypothyroidism, levothyroxine therapy improves cardiac contractility and stroke volume, as demonstrated by reversibility in some of the echocardiographic parameters [20, 21].

Our patient suffered from severe pulmonary edema, heart failure, dilated cardiomyopathy, and normochromic normocytic anemia, all of which was most likely a consequence of severe thyroid gland insufficiency as the primary pathology. We have given due consideration to the possibility of other pathology (*e.g.*, sarcoidosis) for this multiorgan disorder, but we felt that this diagnosis is unlikely based on a careful history, physical examination, echocardiography findings, laboratory tests, and resting ECG findings.

CONCLUSION

This case report emphasizes the importance of considering thyroid gland disorders as a potential pathology in individuals with congestive heart failure. It is highly recommended that clinicians routinely screen for thyroid function in patients with dilated cardiomyopathy.

AUTHORS' CONTRIBUTIONS

S.T.: Concept, original manuscript draft, data collection, figure formatting; N.B.: Concept, manuscript revision.

LIST OF ABBREVIATIONS

ECG	=	Electrocardiogram
RBC	=	Red blood cell
WBC	=	White blood cell
TSH	=	Thyroid-stimulating hormone
LV	=	Left ventricle
LDL	=	Low-density lipoprotein
HDL	=	High-density lipoprotein
ECG	=	Electrocardiogram
WBC	=	White Blood Cell
RBC	=	Red Blood Cell
MCV	=	Mean Corpuscular Volume
MCH	=	Mean Corpuscular Hemoglobin
RDW	=	Red Blood Cell Distribution Width
ESR	=	Erythrocyte Sedimentation Rate
LDL	=	Low-density Lipoprotein
HDL	=	High-density lipoprotein
GS	=	Global Strain
TSH	=	Thyroid-stimulating HormoneLV
LV	=	Left Ventricle
RAAS	=	Renin-angiotensin-aldosterone System

CONSENT FOR PUBLICATION

Written informed consent for publication of the case report and any accompanying images was obtained from the patient.

STANDARDS OF REPORTING

CARE guidelines were followed.

AVAILABILITY OF DATA AND MATERIALS

The data supporting the findings of the article is available in the patient's electronic medical record at Dubai Hospital.

FUNDING

None.

CONFLICT OF INTEREST

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

ACKNOWLEDGEMENTS

Declared none.

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