Severe Hypothyroidism, Coronary Artery Disease on CT Coronary Angiography and Hypoperfusion on Contrast Echocardiography

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Article ID: WMC003825
Article Type: Case Report
Submitted on: 15-Nov-2012, 05:49:38 AM GMT  Published on: 15-Nov-2012, 05:58:06 PM GMT
Article URL: http://www.webmedcentral.com/article_view/3825
Subject Categories: CARDIOLOGY
Keywords: Hypothyroidism, Coronary Artery Disease, Microvascular Coronary Artery Disease, CT Coronary Angiography, Contrast Echocardiography

How to cite the article: Kanazirev B, Georgieva J, Bachvarova M, Dimova M. Severe Hypothyroidism, Coronary Artery Disease on CT Coronary Angiography and Hypoperfusion on Contrast Echocardiography. WebmedCentral CARDIOLOGY 2012;3(11):WMC003825

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Article Video: http://www.webmedcentral.com//article_video/3825
Source(s) of Funding:
No

Competing Interests:
No
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Abstract

The association between overt hypothyroidism (HT) and coronary heart disease is well known. Even subclinical hypothyroidism independently increases the relative risk of coronary artery disease and myocardial infarction and reduces coronary flow reserve. Methods and results A patient with severe HP and typical angina on exertion is presented having multiple epicardial coronary artery disease on CT-assisted coronary arteriography and decreased and heterogeneous myocardial perfusion on contrast echocardiography secondary to both macro and microvascular coronary artery disease. Conclusions: Hypothyroidism is an important clinical situation and a risk factor to be considered for coronary artery involvement.

Introduction

Hypothyroidism is an important risk factor for coronary artery disease and heart failure. Thyroid function determines independently the extent and severity of coronary artery disease and leads to increased number of major cardiovascular events and decreased survival (1,2,3) . Even subclinical hypothyroidism independently increases the relative risk of coronary artery disease and myocardial infarction and reduces coronary flow reserve in the absence of epicardial coronary artery disease.(4). The evolving new techniques for coronary artery stenosis visualization and myocardial perfusion disturbances – CT-assisted coronary arteriography and contrast-enhanced echocardiography could be used as non-invasive tests for coronary artery status elucidation in patients with hypothyroidism.

Case Report(s)

Case Report A patient of 61 was admitted to the Department of Medicine after being treated for psychomotor agitation at Outpatient Psychiatry Department with signs and symptoms of severe hypothyroidism-facial puffiness, yellow discoloration of the skin, cold and dry skin, hoarse voice, hearing deficit, slow slurred speech and and typical angina on mild exertion,. Elevated TSH-85 mU/ml, high cholesterol-8,9 mmol/l, BUN-8,1 mmol/l, Hb-129g/l, BP 160/100, HR-65 bpm, normal CPK-MB and Troponin, nonspecific ST-T changes on ECG, enlarged silhouette on AP X-ray were found. Echocardiography showed normal LV volumes with preserved systolic and segmental motion and EF-54%, abnormal relaxation on diastolic transmitral flow, preserved myocardial velocities on TDI and mild pericardial effusion. A CT-assisted coronary angiography was performed on CT Dual Sourse Siemens Definition with 80 ml of contrast (Leovist 370). Contrast echocardiography was performed for left ventricular opacification and myocardial perfusion estimation with SonoVue (Bracco) a second-generation ultrasound contrast agent that consists of microbubbles containing sulfur hexafluoride surrounded by a phospholipid shell with mean size and concentration of microbubbles is 2.5 μm and 1 to 5•10³•ml–1, respectively. It was reconstituted by the addition of normal saline to the final solution of 5 ml with a 10 ml saline flash. Acoustic power and compression were maximized and gain settings were optimized at the onset of study and held constant throughout. Mechanical index was set at 1.6 for flash images and 0.1 for real-time images and contrast images were acquired in apical 4-chamber.

Three-vessel proximal coronary artery disease was found with diffuse involvement of coronary arteries. (Fig.1)

Contrast echocardiography-hyperechogenic myocardium on non-contrast echocardiography with non-homogeneous hypoperfusion of the apical and lateral segments on contrast echocardiography reflecting both increased fibrosis of myocardium and the presence of both macro and microvascular involvement of the myocardium (Fig 2).

Discussion

It is well known that hypothyroidism is a risk factor for earlier and accelerated epicardial coronary...
atherosclerosis and reduced coronary artery flow reserve. In patients with clinically manifested coronary artery disease hypothyroidism is found more often and all-cause mortality and cardiovascular mortality are increased. Reduced coronary artery flow reserve a hallmark of microvascular disease of the coronary arteries is found even in patients with subclinical HT (1,2,3,4).

Evidence from magnetic resonance imaging studies of subclinical hypothyroidism show significantly decreased cardiac preload and an increased afterload with a consequent reduction in stroke volume and cardiac output was found. Diffuse hypopacification of myocardium was mentioned and replacement therapy fully normalized the hemodynamic alterations. (5)

In some patients with severe hypothyroidism thyroxine replacement therapy precipitates or aggravates angina pectoris, whereas in other patients angina pectoris is ameliorated or even disappears. The reason for this paradox is unknown. It has been attributed either to reversible endocrine cardiomyopathy in the form of asymmetric septal hypertrophy (ASH)(9) or reversible anatomical narrowing of the coronary arteries. The results of a recent investigation, in which myocardial performance was surveyed by radionuclide ventriculography throughout early thyroxine replacement therapy in severe hypothyroidism, were compatible with the presence of reversible coronary dysfunction rather than of ASH. Exercise and redistribution tomographic myocardial thallium-201 imaging (SPECT) was performed before thyroxine replacement therapy and repeated after 10 days and again after 2 months during therapy. In patients without coronary artery disease substantial regional perfusion defects were demonstrated after exercise that were normalized at rest or after thyroxine therapy. With restoration of euthyroidism, exercise and redistribution SPECT became normal in every patient. Determination of exact confidence limits reveals that the proportional incidence of myocardial perfusion defects in hypothyroidism, indicating myocardial ischemia, will at least be 22% with 95% probability. Despite the relatively low specificity of SPECT it seems pertinent to conclude that impaired myocardial perfusion as assessed by SPECT probably is due to reversible coronary dysfunction inherent in the hypothyroid state, and that this is not an infrequent manifestation of severe hypothyroidism.(6)

To study the myocardial perfusion in primary hypothyroidism accompanied by cardiac pain patients were examined by using resting and stress 201TI myocardial scintigraphy. At rest all the patients showed impaired myocardial perfusion. A decrease in 201TI accumulation, which corresponded to the areas of impaired perfusion, was observed in 54% of segments. A severe impairment of myocardial 201TI washout was recorded in all the patients. With exercise additional transient myocardial perfusion was found. (7)

Myocardial oxidative metabolism was measured by positron emission tomography with [11C] acetate in patients with hypothyroidism. Cine magnetic resonance imaging was applied to determine left ventricular geometry as well. Compared to hormone replacement state, systemic vascular resistance, left ventricular mass were significantly higher in hypothyroidism. Ejection fraction and stroke work index were significantly lower. Despite an additional reduction of k(mono), i.e. oxidative metabolism, the wall motion index was significantly lower, too. In summary, cardiac oxygen consumption is reduced in hypothyroidism. This reduction is associated with increased peripheral resistance and reduced contractility. Estimates of cardiac work are more severely suppressed than those of oxidative metabolism, suggesting decreased efficiency. These findings may provide an explanation for development or worsening of heart failure in hypothyroid patients with preexisting heart disease. In summary, using a model of short term hypothyroidism and serial application of noninvasive imaging techniques, the present study confirms a decrease in cardiac performance in the hypothyroid state compared to the euthyroid state. Noninvasive measurements of oxidative metabolism, performed for the first time in addition to measurements of cardiac function, demonstrate a reduction of myocardial oxygen consumption in hypothyroidism. This decrease seems to be less pronounced compared to the decrease in cardiac work. Thus, noninvasive estimates of cardiac efficiency suggest that myocardial performance is less efficient in hypothyroidism. (8)

Echocardiographic videodensity textural characteristics are increased in overt and subclinical hypothyroidism due to increased tissue fibrosis and possible interstitial edema with decreased diastolic-systolic variation in videodensity. Impaired systolic and diastolic function with strain and strain rate as well as with tissue was found. To evaluate cardiac function and texture in patients with subclinical hypothyroidism (sHT) both by conventional and new ultrasonic intramyocardial tissue techniques were used. The results of the present study were: (a) the detection in sHT subjects of a lower cyclic variation index (CVI) indicating an altered myocardial intrinsic contractility;
(b) a higher ultrasonic myocardial reflectivity indicating an altered myocardial texture; (c) the detection of lower systolic strain and strain-rate indicating an alteration of myocardial regional deformability; (d) an initial impairment of left ventricular diastolic function indicated by a decrease of peak E mitral flow velocity and an increase of peak A mitral flow velocity. A significant correlation among systo-diastolic modifications detected by Color Doppler myocardial imaging and integrated backscatter and serum TSH levels were found. The CVI at septum, the PWDTI S-peak wave and the systolic strain at septum were inversely related to the serum TSH levels. In conclusion, new echocardiographic techniques allow the early detection of ultrastructural and regional functional systolic and diastolic abnormalities. \(10,11,12,13\)

**Conclusion**

Conclusion: Myocardial tissue characterization is important diagnostic clue in manifest hypothyroidism and new techniques are evolving for evaluation of myocardial perfusion in hypothyroid patients.

**Acknowledgement(s)**

Acknowledgments: We acknowledge our thankfulness to the patients and his relatives for the kind cooperation and consent for elucidation of his condition and for the publication of this case.

**References**

Illustrations

Illustration 1

Fig 1. LAD, Cx and RCA; coronary artery involvement; with high grade proximal stenoses
Illustration 2

Fig.2 Non-homogeneous hypoperfusion of the apical and lateral segments on contrast echocardiography reflecting both increased fibrosis of myocardium and the presence of both macro and microvascular involvement of the myocardium.
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