Thyroid Hormone Disturbance and Atrioventricular Block: Correlation with Cardiogenic Syncope in Young Adult

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Abstract
This report shows that thyroid hormone disturbance has a significant role in the development of cardiovascular sign and symptom in the thyroid patients. And those Cardiac conduction disturbances, namely atrial fibrillation and atrioventricular block, have a role with cardiogenic syncope in non-epileptic patient. We report a patient with hypothyroidism diagnosed with atrioventricular block who developed syncope during sleep.

Keywords: Atrioventricular Block; Syncope; Hypothyroidism

Case Report
A 32-year-old, right-handed woman patient was sent to the hospital for a severe headache at L occipital area, gripping in nature but did not seem to radiate anywhere else. Denies photophobia, neck stiffness/fever. Systems review says no chest pain/SOB palpitation, no bowel motion changes, and no dysuria. With no family history of HTN and T2DM, hyperlipidemia. The patient initially admitted under the care of neuro team and subsequently transfer of care of cardiology, EEG was normal CT brain was done shown normal study. There is no established infarct or acute intracranial hemorrhage seen. No mass effect or hydrocephalus is demonstrated. She was referred to cardiology team as her ECG showed intermittent AV dissociation with LBBB pattern (Figure 1a, b). Cardiac enzymes were normal. Electrolytes, including calcium/magnesium/phosphate were normal. Her TFTs show low TSH with normal T3 and T4 (she is on thyroxine replacement for hypothyroidism). Her echocardiogram report shows IVS/AVS are intact. She was moved to cardiac care unit for further monitoring (Figure 2). While inpatient, she has one episode of giddiness with the blurring of vision, no palpitation/sweating/nausea/LOC. The patient was put on holter which showed intermittent AV dissociation, min hour 43 Max HR 135, No sig pause (1.99sec), subsequently patient was put on continuous monitoring. Telemetry which again showed intermittent AV dissociation. Before patient was discharged Neuro-team reviewed once more as a differential to patient’s presentation is an underlying epileptic disorder. Neuro-team unconvinced that it is a seizure disorder. According to her previous history, she has been on thyroxin 100 µg (daily) for 8 years. From last 3 years, she was having syncope during sleep. This syncope/seizure last for 1 - 2 minutes occurred at a frequency of three to five in a year.

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Figure 1a: ECG showing of sequences of ventricular complexes marked left axis deviation with the heart rate 66.

Figure 1b: ECG showing of sequences of multiform premature ventricular complexes marked left axis deviation with the heart rate 61 BPM.

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Discussion

We report a case of the atrioventricular block associated with cardiogenic syncope in a hypothyroid patient. Thyroid hormone has a role in cardiac gene expression. Both structural and functional genes in cardiac myocyte are mediated by thyroid hormone (Table 1) [1].

<table>
<thead>
<tr>
<th>Positively Regulated</th>
<th>Negatively Regulated</th>
</tr>
</thead>
<tbody>
<tr>
<td>αMyosin heavy chain</td>
<td>βMyosin heavy chain</td>
</tr>
<tr>
<td>Sarcoplasmic reticulum Ca2⁺-ATPase</td>
<td>Phospholamban</td>
</tr>
<tr>
<td>Na⁺/K⁺-ATPase</td>
<td>Adenylyl cyclase catalytic subunits</td>
</tr>
<tr>
<td>β1-Adrenergic receptor</td>
<td>Thyroid hormone receptor 1</td>
</tr>
<tr>
<td>Atrial natriuretic hormone</td>
<td>Na⁺/Ca2⁺ exchanger</td>
</tr>
<tr>
<td>Voltage-gated potassium channels</td>
<td>(Kv1.5, Kv4.2, Kv4.3)</td>
</tr>
</tbody>
</table>

*Table 1: Effect of Thyroid Hormone on Cardiac Gene Expression.*

Adopted from (Grais IM and Sowers JR 2014).

Thyroid hormone has also played role in regulation of action potential in cardiac myocytes [2]. Sinoatrial node is responsible for the generation of action potential in the heart. It is a physiological pacemaker for the heart [3]. The pacemaker-related genes, hyperpolarization activated cyclic nucleotide-gated channels 2 and 4, are transcriptionally regulated by thyroid hormone [4]. Two symptomatic conditions of thyroid hormone have a significant effect on a heart condition. Hypothyroidism is associated with decreased cardiac contractility, decreased cardiac output, and accelerated atherosclerosis [5]. Hypothyroidism causes abnormal expression of cardiac genes, therefore, it can cause physiological changes in the heart (Table 2) [6,7]. It may be a cause of complete AV block and ventricular tachycardia [8]. However, the mechanism of conduction disturbance in the heart remains unknown. In most of the cases, cardiac syncope/AV block was
reported in elderly patients and it is sometimes associated with severe hypothyroidism. After thyroid hormone replacement therapy AV conduction was reversed [9]. In our case, she was hypothyroid patient since 8 years. She was on thyroxine replacement therapy, however, for the last three years she has syncope and this syncope occurs during sleep. During hospitalization, she was put on holter which showed intermittent AV dissociation, she was put on continuous monitoring. Telemetry which again showed intermittent AV dissociation. However, no syncopal event was reported during hospitalization. Before she was discharged Neuro-team reviewed once more as a differential to patient’s presentation is an underlying epileptic disorder. Neuro-team unconvinced that it is a seizure disorder. Therefore, she has taken for further investigation and evaluation to differentiate from cardiac from non-cardiac causes. And treatment will be directed toward correcting the specific cause responsible for syncopal event and preventing any subsequent morbidity or mortality.

<table>
<thead>
<tr>
<th>Impaired cardiac contractility and diastolic function</th>
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<tbody>
<tr>
<td>Increased systemic vascular resistance</td>
</tr>
<tr>
<td>Decreased endothelial-derived relaxation factor</td>
</tr>
<tr>
<td>Increased serum cholesterol</td>
</tr>
<tr>
<td>Increased C-reactive protein</td>
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<tr>
<td>Increased homocysteine</td>
</tr>
</tbody>
</table>

**Table 2: Cardiovascular Risks Associated with Hypothyroidism.**
Adopted from (Grais IM and Sowers JR 2014).

**Bibliography**


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