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Case Report
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Fatal Arrhythmia with Brugada-Type Electrocardiograms in a Patient with Primary Hyperparathyroidism: A Rare Case Report

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Abstract

Background: Primary Hyperparathyroidism (PHPT) is a calcium-related metabolic disorder characterized by hypercalcemia and excessive secretion of Parathyroid Hormone (PTH). PHPT can manifest with nephrolithiasis and osteoporosis as well as with vertebral fractures. Recent studies have investigated cardiovascular findings in PHPT, including asymptomatic coronary artery disease, valve calcification and left ventricular hypertrophy, nephrocalcinosis is a possible complication of hyperparathyroidism. Fatal arrhythmias, such as Brugada-type electrocardiograms, have been described in only a few case reports of PHPT.

Case Summary: Here, we present the case of a 53-year-old male with episodic palpitations, syncope and paroxysmal ventricular fibrillation who had a high risk of sudden death. Electrocardiogram (ECG) findings during hospitalization were characterized by a coved ST-segment elevation in the right precordial leads, similar to Brugada syndrome. A single-chamber Implantable Cardioverter-Defibrillator (ICD) was implanted, and ventricular fibrillation was repeatedly recorded. Other systemic symptoms of PHPT included kidney stones, persistently high calcium and low phosphorus levels, hypokalemia, and severe osteoporosis. The diagnosis of PHPT was made according to elevated levels of calcium (2.9 mmol/L, normal range: 2.11 mmol/L to 2.52 mmol/L) and PTH (40.85 pmol/L, normal range: 1.6 pmol/L to 6.9 pmol/L). A parathyroid adenoma was detected by parathyroid ultrasound and CT scan; it was located in the left lesion and was successfully exhibited by increased technetium-99m Methoxyisobutylisonitrile (99mTc-MIBI) uptake. Postoperatively, PTH levels normalized, as the serum calcium level remained in the normal range after parathyroidectomy. No arrhythmia event occurred during the 1-year follow-up.

Conclusion: We described a rare case of hyperparathyroidism presenting as hypercalcemia and fatal arrhythmia. The evidence that the arrhythmia was resolved following the resolution of PHPT after surgery supports our results.

Keywords: Brugada-type electrocardiograms; Primary hyperparathyroidism; Hypercalcemia

Core Tip

Hypercalcemia-induced fatal arrhythmia, which acts as the typical symptom in hyperparathyroidism, is rarely reported. We intend to remind clinicians that primary hyperparathyroidism should be considered in patients with hypercalcemia-related arrhythmias.

Introduction

Primary Hyperparathyroidism (PHPT) is a disorder of hypercalcemia caused by excessive and inappropriate secretion of parathyroid hormone, which can lead to bone loss, kidney stones, decreased kidney function, and various neurocognitive, gastrointestinal and musculoskeletal disorders [1,2]. According to foreign reports, the incidence rate of PHPT in the population is approximately 0.86%, and the incidence ratio of males to females is 1:2~1:4 [3]. Studies have shown that patients with PHPT have a higher incidence of hypertension, diabetes, dyslipidemia, endothelial dysfunction, arrhythmia, and left ventricular hypertrophy [4]. Arrhythmias caused by hyperparathyroidism are related to hypercalcemia and often manifest as tachycardia, premature beats and ventricular fibrillation, etc. [5]. However, fatal arrhythmias manifesting as ventricular

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fibrillation are relatively rare, especially those caused by Brugada-type electrocardiograms in patients with hyperparathyroidism [6,7]. All clinicians should be aware of the possibility of fatal arrhythmia with Brugada-type electrocardiograms in patients with PHPT.

Case Presentation

Chief complaints

A 53-year-old Chinese male was admitted to the outpatient department with recurrent episodic palpitations and syncope.

History of present illness

The patient was admitted to hospital with repeated palpitations and sudden syncope; when the attack occurred, he turned purple, his eyes rolled upward, and he foamed at the mouth, stopped breathing, and had tonic convulsions of the limbs, followed by incontinence. The family performed Cardiopulmonary Resuscitation (CPR) on him. Afterward, the patient recovered his breathing, regained consciousness, and could not recall the incident. The palpitations were relieved, and there was no obvious chest pain or other discomfort.

History of past illness

The patient had a history of kidney stones and osteoporosis for 5 years.

Personal and family history

No significant personal or family history was identified.

Physical examination

The patient's physical examination results were normal.

Laboratory examinations

The ECG results showed sinus rhythm, right axis deviation, and ST segment changes (V1-3 saddle elevation 0.15 mV to 0.55 mV) (Figure 1). The serum potassium level was 3.49 mmol/L, the serum calcium level was elevated (2.9 mmol/L), and the serum phosphorus level was below the normal range (0.8 mmol/L). The level of parathyroid hormone was 40.85 pmol/L and 24-h urinary calcium was elevated. Other examination results were within the normal range. The routine blood biochemical and endocrine hormone test results are shown in Table 1. The results of other endocrine hormone tests were not suggestive of Multiple Endocrine Neoplasia (MEN).

Imaging examinations

Parathyroid adenoma was found by parathyroid ultrasound examination. Neck B-ultrasound showed multiple mixed nodular lesions on the bilateral thyroid, including pseudo-TI-RADS class 3, a heterogeneous hyperechoic mass located below the lower pole of the left thyroid, leading us first to consider the possibility of parathyroid hyperplasia (Figure 2A). The patient's abdominal ultrasound showed multiple stones in the right kidney, and bone mineral density showed osteoporosis (spine T score was -2.5). The patient had undergone MIBI examination in another hospital, and the results showed that the left sub thyroid nodule had increased radioactive uptake. The adenoma of the left-sided lesion was successfully manifested due to increased uptake of 99mTc-MIBI (Figure 2B).

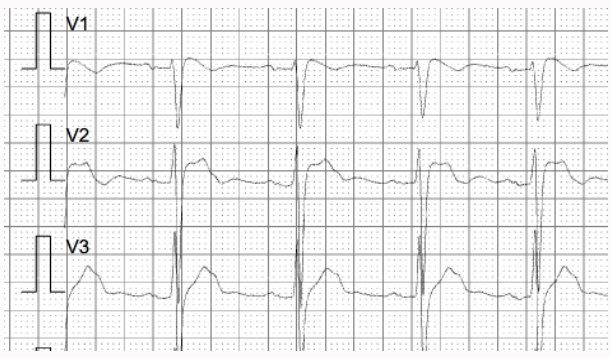

Figure 1: The ECG result is sinus rhythm, right axis deviation, ST segment changes: V1-3 saddle elevation 0.15 mV to 0.55 mV.

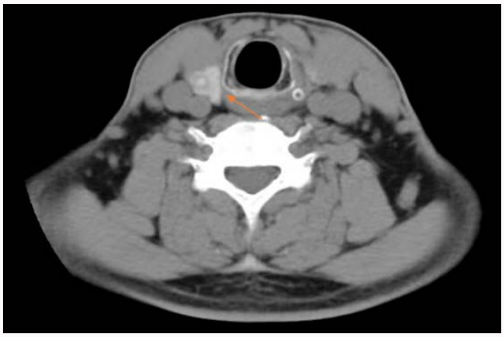

Figure 2A: Neck B-ultrasound shows multiple mixed nodular lesions of bilateral thyroid: Pseudo-TI-RADS class 3, a heterogeneous hyperechoic mass below the lower pole of the left thyroid, first consider the possibility of parathyroid hyperplasia.

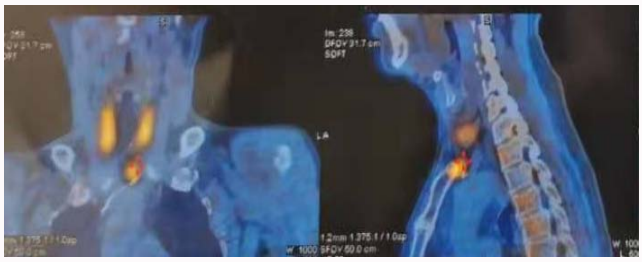

Figure 2B: The adenoma of the left-sided lesion was successfully manifested due to increased uptake of 99mTc MIBI.

Final diagnosis

Hyperparathyroidism was diagnosed based on the elevation of calcium 2.9 mmol/L and parathyroid hormone 40.85 pmol/L. This led to the diagnosis of PTH-dependent hyperparathyroidism. Imaging and functional tests identified parathyroid adenoma as the cause of hyperparathyroidism.

Treatment

Patient had recurrent palpitations and fatal arrhythmias, so a single-chamber Implantable Cardioverter-Defibrillator (ICD) was implanted after syncope, and a heterogeneous hyperechoic mass below the lower left thyroid was surgically removed.

Outcome and follow-up

A single-chamber ICD was implanted to avoid fatal arrhythmias and sudden death. The patient was treated surgically, and the parathyroid adenoma was removed. After excision, the patient's serum calcium decreased to 2.36 mmol/L, serum phosphorus increased to 1.02 mmol/L, parathyroid hormone decreased to 6.98 pmmol/L, and serum potassium increased to 3.94 mmol/L (Figure 3). The postoperative electrocardiogram showed a normal range (Figure 4). The patient's indices returned to normal, and there was no fatal arrhythmia or electrolyte disturbance during the 1-year follow-up.

Table 1: The routine blood biochemical and endocrine hormone test results.

Index	Case	Normal range
FPG, mmol/L	5.7	3.5-5.3
HbA1c, %	5.5	4-6
Serum calcium, mmol/L	2.88	2.2-2.7
Serum phosphorus, mmol/L	0.75	0.85-1.51
Serum potassium, mmol/L	3.24	3.5-5.3
24-hour urine calcium, mmol/24 h	7.04	2.5-7.5
Albumin, g/L	45	40-55
Alkaline phosphatase, U/L	283	45-125
eGFR, ml/min/1.73 m2	136.1	>60
Vitamin D, ng/ml	23.43	>29
PTH, pmol/L	41.43	1.6-6.9
β-CTX, ng/ml	2.72	0.1-0.65
Total cholesterol, mmol/L	5.05	0-5.2
Triglycerides, mmol/L	2.23	0-1.7
LDL cholesterol, mmol/L	3.43	<2.6
Growth hormone, ug/L	0.268	0-3
Cortisol, ug/dl	12.41	4.26-24.85
Adrenocorticotropic hormone, pg/ml	20.67	7.2-63.4
Aldosterone, pg/ml	97.55	10-160
Renin, pg/ml	33.48	4-24
ARR	2.91	/

ARR: The Ratio of Aldosterone to Renin

Discussion

Hyperparathyroidism is a benign overgrowth of parathyroid tissue; it can affect a single gland (80% of cases) or be a multiglandular disease (15% to 20% of cases) [8]. Extensive data have been published on the relationship between PHPT and arrhythmias [9]. Hyperparathyroidism can lead to ST segment and QT interval prolongation with hypercalcemia because increased leakage of Sarcoplasmic Reticulum (SR)-ionized Calcium (Ca^{++}) and increased exchanger activity may increase the risk of supraventricular arrhythmias [10,11]. In this rare case, a patient presented with an ECG typical of Brugada syndrome, which is characterized by ST-segment elevation in the right precordial leads and an increased risk of Sudden Cardiac Death (SCD) in the absence of structural abnormalities [12,13]. Hyperparathyroidism can cause hypercalcemia, which is associated with a variety of electrophysiological changes, including shortened QT interval, decreased cardiac conduction, and elevated J-point, all of which can form the basis of arrhythmias [6]. This patient had recurrent palpitations and syncope. An ICD was installed, and multiple electrical discharge activities were recorded. The treatment of hyperparathyroidism has been reported. Drugs such as phosphate, mitomycin, gallium nitrate, and calcitonin can treat hypercalcemia, but their efficacy is relatively short-lived, and there are some toxic side effects. Bisphosphonates, a new bone resorption inhibitor, have been reported to be particularly safe [14]. Minimally invasive Parathyroidectomy (PTX) represents the treatment of choice for symptomatic patients and has many advantages [15,16]. No medical treatment, single or combined, will cure PHPT; however, this is not to say that all patients should undergo surgery. PTX decisions should always be made under conditions of safety, and the potential benefits of medical treatment should not be overshadowed by surgery or outweighed by the risks of anesthesia [17,18]. For this patient, the benefits of the operation outweighed the disadvantages. After the operation, all indicators improved, and there was no recurrence of symptoms. It is worth mentioning that this patient had recurrent hypokalemia, leading us to consider whether hyperparathyroidism is related to hypokalemia. Reports have shown that hypokalemia

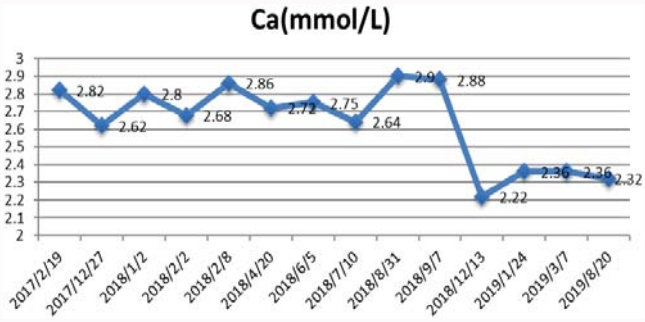

Figure 3A: Changes of serum calcium indexes in patients.

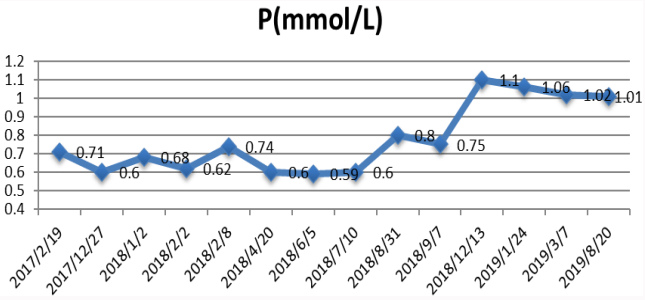

Figure 3B: Changes of serum phosphorus indexes in patients.

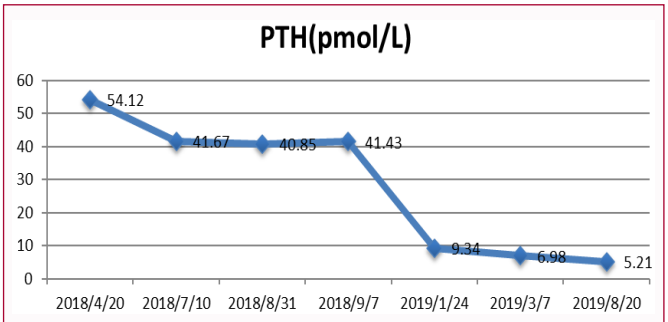

Figure 3C: Changes of parathyroid hormone in patients.

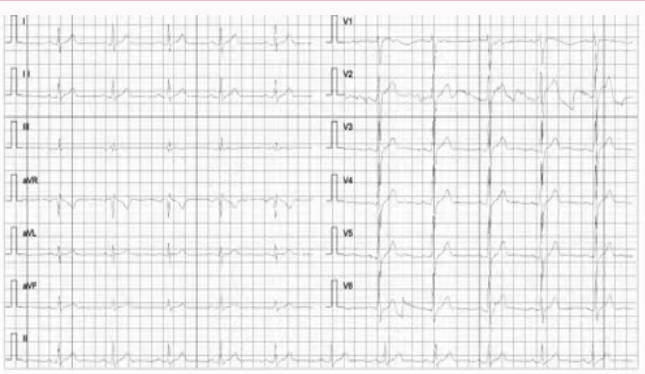

Figure 4: The patient's electrocardiogram after surgery showed within the normal range.

occurs in approximately one-sixth of patients with PHPT (prevalence 16.9%) [19]. Studies have also shown that hypercalcemia activates Henle crude upper extremity calcium receptors, inactivates sodium-potassium-2-chloride cotransporters, and induces hypokalemic metabolic alkalosis under the action of aldosterone, similar to the loop diuretic furosemide [20,21]. Therefore, with the vigorous use of diuretics while treating hypercalcemia, serum potassium levels must be monitored throughout treatment.

Conclusion

We described a rare case of hyperparathyroidism presenting as hypercalcemia and fatal arrhythmia. The evidence that the arrhythmia was resolved following the resolution of PHPT after surgery supports our results. It is necessary to remind clinicians to consider hyperparathyroidism in the face of fatal arrhythmias in patients with electrolyte disturbances. And the patient can be treated with defibrillation and pacemaker only after a clear diagnosis; otherwise it will bring unnecessary invasive treatment and economic burden.

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