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Electrical Storm in a Case of Bilateral Pheochromocytomas

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Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
Literature Search F
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Conflict of interest: None declared

Patient: **Male, 63-year-old**
Final Diagnosis: **Electrical storm**
Symptoms: **Hypotension • syncope**
Medication: —
Clinical Procedure: —
Specialty: **Cardiology**

Objective: **Rare disease**

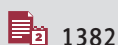
Background: Pheochromocytomas are catecholamine-secreting tumors that develop within the chromaffin cells of the adrenal glands. They most commonly present with hypertension, and the classic triad of symptoms is headaches, palpitations, and diaphoresis. Electrical storm (ES) is defined as at least 3 sustained episodes of ventricular tachycardia (VT), ventricular fibrillation (VF), or appropriate shocks from an implanted cardioverter-defibrillator (ICD) within 24 h. We discuss the case of a 63-year-old man with known bilateral pheochromocytomas who presented with ES prompting multiple ICD shocks, possibly exacerbated by catecholamine surge from his adrenal tumors.

Case Report: The patient was a 63-year-old man with an extensive medical history including ischemic cardiomyopathy and congestive heart failure with reduced ejection fraction presented with multiple syncopal episodes secondary to persistent monomorphic ventricular tachycardia (MMVT), polymorphic ventricular tachycardia (PMVT), and VF requiring ICD shocks. He had known bilateral pheochromocytomas. ES was attributed to catecholamine excess in the setting of these tumors, so VT ablation was deferred pending tumor removal. Alpha blockade was initiated preoperatively, and the patient subsequently underwent bilateral adrenalectomy; however, he continued to sustain tachyarrhythmias and eventually died despite resuscitative efforts.

Conclusions: Bilateral pheochromocytomas are rare adrenal tumors. In even more infrequent situations, they can cause ES secondary to adrenergic stimulation from catecholamine surges. It is worth considering pheochromocytoma in patients with refractory ES, as treating these tumors could potentially reduce the frequency of this dangerous arrhythmia.

Keywords: **Arrhythmias, Cardiac • Pheochromocytoma • Tachycardia, Ventricular**

Full-text PDF: <https://www.amjcaserep.com/abstract/index/idArt/929507>



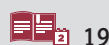
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Background

Pheochromocytomas are catecholamine-secreting tumors derived from chromaffin cells in the adrenal medulla [1]. Approximately 40% of cases are part of a familial syndrome, such as Multiple Endocrine Neoplasia 2 or Von Hippel-Lindau, but the majority are non-familial [2,3]. Patients can be asymptomatic and the tumors are found incidentally. Symptoms of the tumor, when present, are caused by the excess release of catecholamines. The most common presenting symptom is hypertension, with orthostasis and cardiomyopathy occurring less frequently. While the classic triad of symptoms is headache, diaphoresis, and palpitations, it is unlikely for a patient to have all 3 [2-4].

Electrical storm (ES) is defined as at least 3 sustained episodes of ventricular tachycardia (VT), ventricular fibrillation (VF), or appropriate shocks from an ICD within 24 h [5]. Here, we describe the rare case of a patient with known bilateral pheochromocytomas who endured repeated episodes of monomorphic VT (MMVT), polymorphic VT (PMVT), and VF requiring multiple ICD shocks, ultimately leading to his death.

Case Report

A 63-year-old man with an extensive medical history including ischemic cardiomyopathy status post CABG (3-vessel disease, with left internal mammary artery Y graft to LAD and diagonal arteries) 19 years prior to admission and percutaneous coronary intervention to the left circumflex artery, congestive heart failure with ejection fraction of 19% requiring ICD placement for primary prevention (Boston Scientific Subcutaneous ICD, model number 1010, implanted 5 years prior to admission), persistent atrial fibrillation, hypertension, and non-Hodgkin's lymphoma treated with bendamustine/rituximab (in remission for 3 years prior to admission), presented with multiple syncope episodes secondary to persistent MMVT, PMVT, and VF requiring ICD shocks. He had previously visited another hospital for the same presentation and underwent cardiac catheterization. There were no significant stenoses that required revascularization, and his prior stents and grafts were patent. The patient was sent home on amiodarone and mexiletine, but subsequently experienced 6 more ICD shocks and 3 syncope episodes. Device interrogation demonstrated MMVT initiated by repetitive unifocal premature ventricular complexes (PVCs), a shock that successfully converted the MMVT, and then subsequent VF 7 s following the shock that was not initiated by the same PVC (Figure 1). No EKG was available at

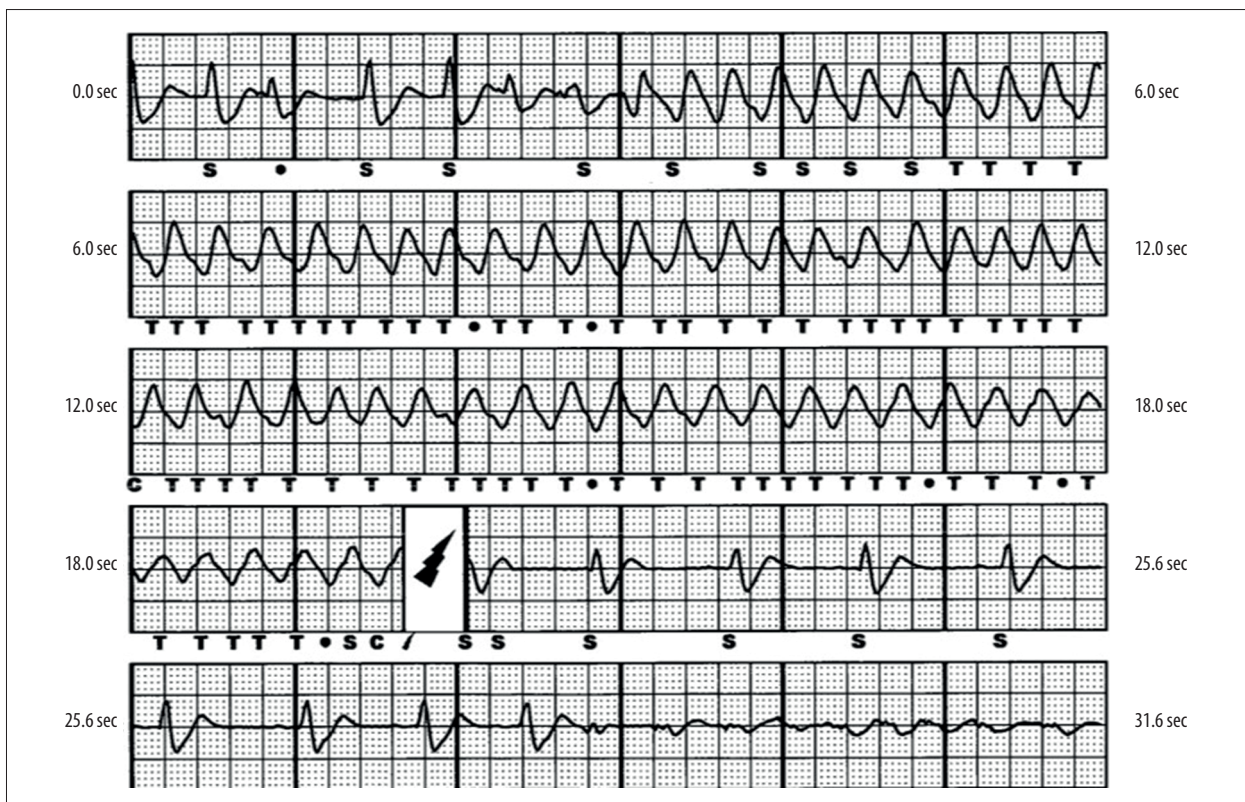


Figure 1. Representative episode of appropriate ICD therapy for VT/VF. MMVT is initiated by repetitive unifocal PVCs. While the shock successfully converted the MMVT, the patient went into VF 7 s later (not initiated by the same PVC).

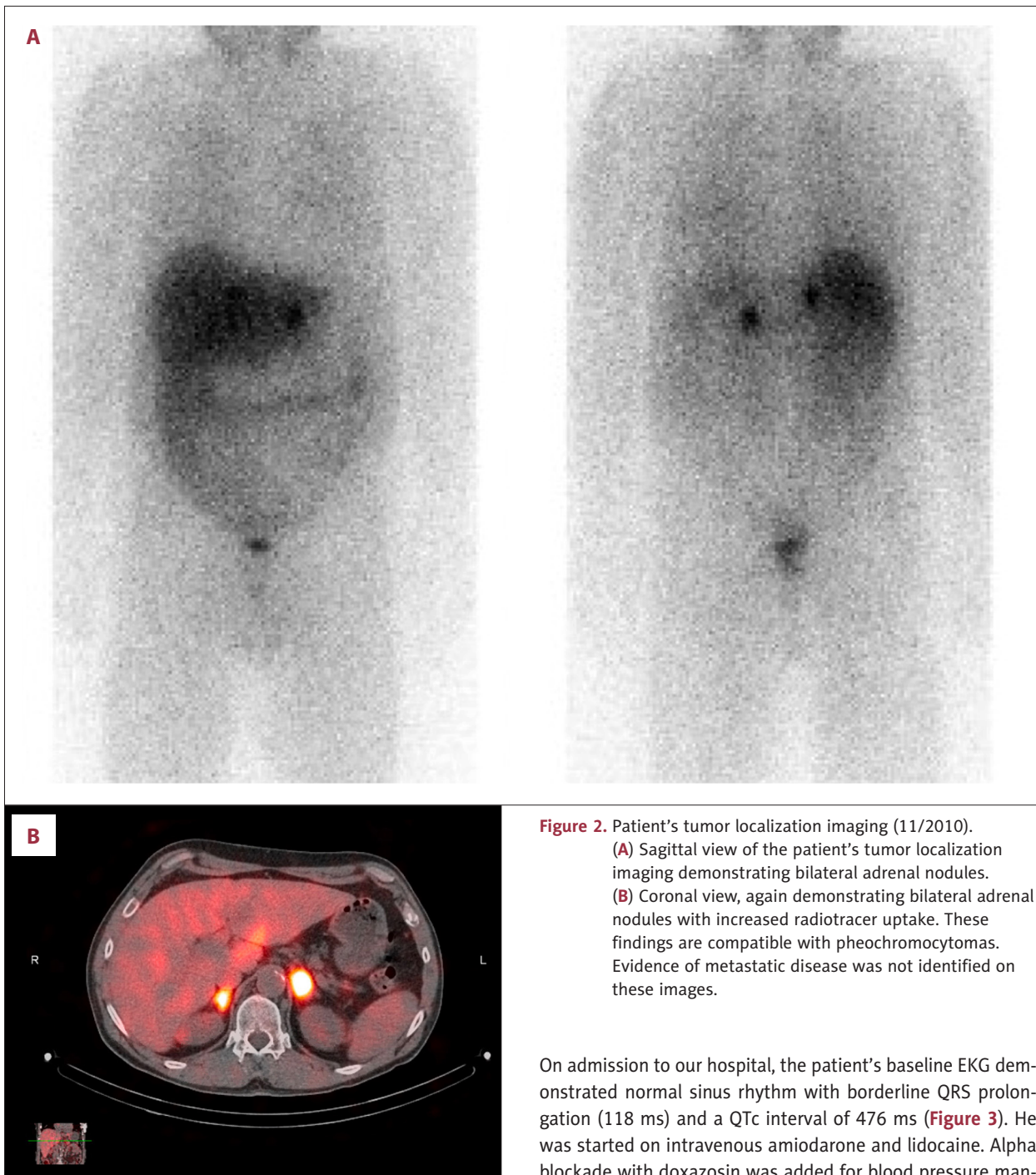


Figure 2. Patient's tumor localization imaging (11/2010).
(A) Sagittal view of the patient's tumor localization imaging demonstrating bilateral adrenal nodules.
(B) Coronal view, again demonstrating bilateral adrenal nodules with increased radiotracer uptake. These findings are compatible with pheochromocytomas. Evidence of metastatic disease was not identified on these images.

the time of these events as they occurred out of hospital. Of note, the patient had been incidentally diagnosed with biopsy-proven bilateral pheochromocytomas during routine imaging for lymphoma surveillance and had an elevated plasma metanephrine level to 4.84 nmol/L (normal range 0.00-0.89 nmol/L) on lab work 1 year prior to presentation (**Figure 2**). Serial plasma metanephrine levels were not obtained.

On admission to our hospital, the patient's baseline EKG demonstrated normal sinus rhythm with borderline QRS prolongation (118 ms) and a QTc interval of 476 ms (**Figure 3**). He was started on intravenous amiodarone and lidocaine. Alpha blockade with doxazosin was added for blood pressure management in the setting of pheochromocytoma at the recommendation of the endocrinology consultant and consistent with guidelines from the Society for Endocrinology for pre-operative management in patients with pheochromocytoma [6]. The ventricular tachyarrhythmias were at first presumed to be exacerbated by catecholamine surges from his bilateral adrenal tumors. VT ablation was deferred pending tumor removal. As a result, the patient underwent surgical robotic bilateral adrenalectomy (converted to open). Bilateral cortical sparing

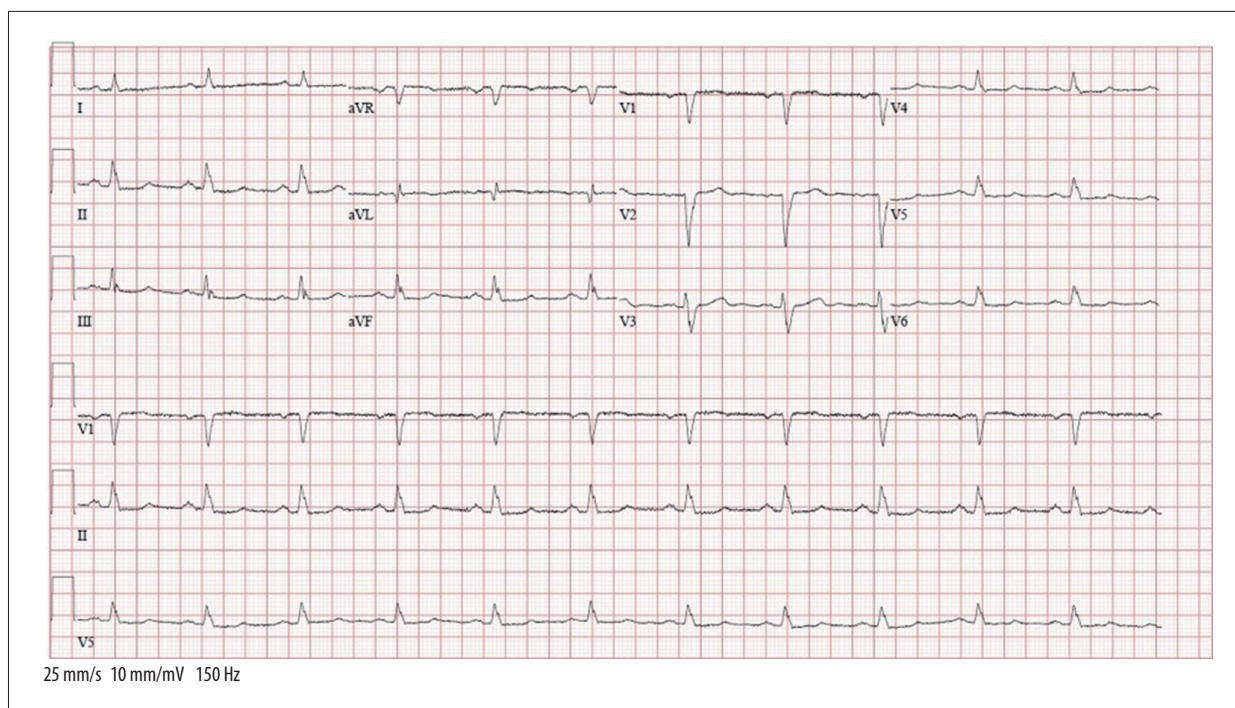


Figure 3. Patient's baseline EKG. Obtained on the date of admission, 1 day after he experienced electrical storm and multiple appropriate shocks from his ICD. EKG demonstrates normal sinus rhythm (rate 68 beats per minute) with borderline QRS prolongation (QRS interval of 118). PR interval was 188 with a QT interval of 448 (QTc 476).

was achieved. Surgical pathology demonstrated a right pheochromocytoma measuring 2.3 cm in diameter and a left pheochromocytoma measuring 3.6 cm in diameter, both with free resection margins and no lympho-vascular invasion. Tumors were described as histologically similar without mitotic figures in 10 high-power fields. Intraoperatively, the patient suffered VF requiring defibrillation. He was transferred to the surgical ICU postoperatively and was managed with hydrocortisone every 6 h as well as amiodarone and lidocaine drips to prevent VT/VF. Noradrenaline was also required to maintain appropriate mean arterial pressure. In the days following surgery, he endured multiple episodes of VT with ICD shocks. He was planned for transfer to the cardiac critical care unit where stellate ganglion blockade was being considered; unfortunately, he developed incessant VF again on post-operative day 3 and died despite aggressive resuscitation measures. Autopsy was not conducted per discussion with patient's next-of-kin. His clinical course is summarized in **Figure 4**.

Discussion

ES is defined as at least 3 sustained episodes of VT, VF, or appropriate shocks from an ICD within 24 h [5]. Case reports have described the cardiac effects of unilateral pheochromocytomas, including acute coronary syndrome, VT, and Takotsubo cardiomyopathy, and some have reported VT as the first presenting

symptom of pheochromocytomas [5,7-11]. Despite these reports, VT remains an uncommon sequela of these tumors [12,13].

Our case describes a patient who not only had bilateral pheochromocytomas, a rare diagnosis, but persistent ES that incorporated 3 different tachyarrhythmias: MMVT, PMVT, and VF [14]. While he had a significant cardiac history, the ES may have been driven further by catecholamine excess from his tumors. Lab work from 1 year prior to presentation demonstrated a plasma metanephrine level of 4.84 nmol/L. This patient did not experience hypertension and had only 1 of the classic triad of symptoms (palpitations); instead, he was largely hypotensive with transient episodes of lightheadedness, a more unique manifestation of catecholamine excess. There are a few possible mechanisms of hypotension in pheochromocytoma, including downregulation of alpha-1 receptors and ultimately reduced systemic vascular resistance [15]. This patient's substrate for VT was most likely chronic ischemic cardiomyopathy, as the bendamustine/rituximab regimen that he received for lymphoma is rarely cardiotoxic. Progression of his ejection fraction was not available as his prior cardiac care was completed at outside institutions; however, the ejection fraction on admission was 19%, as previously described. While the patient was prescribed appropriate heart failure medications, carvedilol use was suboptimal as the patient felt it contributed to his lightheadedness and to his hypotension. As a result, dosing was low and the medication was often declined.

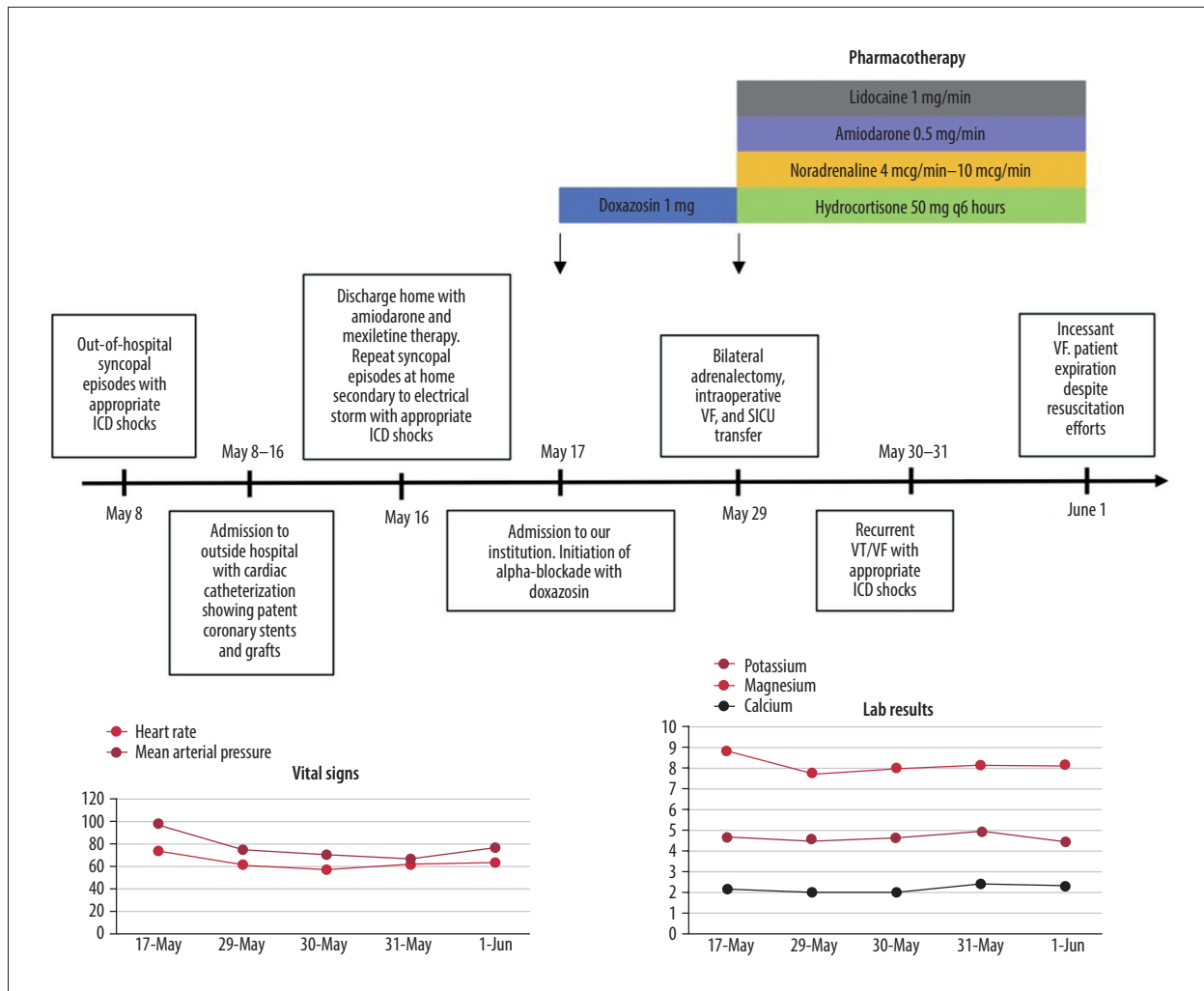


Figure 4. Summary of the patient's clinical course. Demonstrates a timeline of the patient's clinical course, beginning with his first out-of-hospital syncopal episodes.

Not only do multiple ICD shocks decrease quality of life, but recurrent ICD shocks and recurrent VT can worsen left ventricular systolic function and exacerbate heart failure via activation of the adrenergic nervous system [16]. It is therefore vital to identify and properly diagnose the cause of ES in order to treat it appropriately. Initial management includes amiodarone and beta-blocker therapy [17]. Those who are refractory to pharmacologic treatment are candidates for radiofrequency catheter ablation. Based on both the AVID and MADIT-II trials, prognosis in patients with ES was poor, and the risk of death within 3 months of the event was increased [5].

In the case of VT driven by catecholamine excess in the setting of pheochromocytoma, a possible treatment is the removal of the tumor(s) once appropriate pharmacologic alpha blockade has occurred [3,4]. Unfortunately, in the case of our patient, surgery was not curative. This is likely multifactorial, as he had multiple other comorbidities, including CAD with

history of CABG and PCI, as well as significant heart failure with reduced ejection fraction. Pheochromocytoma resection itself yields high morbidity and mortality risk, in particular related to cardiovascular complications, as discussed in a study by Bai et al [18]. Mortality rates are as high as 50% in general, and independent risk factors for cardiovascular morbidity were identified as low BMI, coronary heart disease, large tumor size, lack of crystal or colloid fluid administration preoperatively, and intraoperative hemodynamic instability [18]. Our patient demonstrated at least 2 of these independent risk factors, including coronary heart disease and intraoperative hemodynamic instability, which likely contributed to the multiple tachyarrhythmias postoperatively that ultimately led to his death (Figure 4). Trialing endocardial VT ablation first to address scar substrate may have been an option if able to be performed under conscious sedation, as this patient was deemed a poor candidate for general anesthesia. Typically, catecholamine levels following adrenalectomy would be rechecked 2

weeks postoperatively and if still elevated could indicate residual tumor or metastases [19]. While it is not warranted or feasible to screen every patient with ES for pheochromocytoma, this case highlights the utility of considering pheochromocytomas in individuals with otherwise unexplained or refractory ES, as this can be an atypical presentation of this tumor.

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Conclusions

Bilateral pheochromocytomas are rare adrenal tumors. In even more infrequent situations, they can cause ES secondary to adrenergic stimulation from catecholamine surges. It is worth considering pheochromocytoma in patients with refractory ES, as treating these tumors could potentially reduce the frequency of this dangerous arrhythmia.

Conflicts of Interest

None.