



CASE REPORT

Early Recognition of Pulmonary Edema with OptiVol Fluid Index

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Introduction

Heart failure is the leading cause of hospital admissions for patients above 65 years and accounts for 3% of total national health care budget.¹ The largest share is due to hospitalization and re-hospitalization of these patients.² In-hospital mortality is 6.9% which increases to 10% in the following two to three months. One-year mortality is approximately 35% and there is a 24% risk of readmission.^{3,4} One of the main reasons for morbidity and mortality is the absence of reliable markers for early recognition of decompensated heart failure and the lack of markers to check efficacy of long term treatments.⁵ The methods used clinically for diagnosing heart failure (e.g., shortness of breath, exercise intolerance, weight gain, edema) are not reliable and may even be absent or not recognized in some patients.^{6,7} Newer modalities of identifying fluid accumulation such as OptiVol fluid index have been useful in managing patients with heart failure.⁸

Congestive heart failure pathology is complex and involves severe hemodynamic and neurohumoral alterations.^{3,8} In patients with diastolic and systolic heart failure, the increased left ventricular filling pressures can cause increased left atrial pressures and pulmonary edema from pulmonary venous congestion. These changes cause congestive symptoms. Hemodynamic alteration is a consistent finding and is the earliest change in the decompensation process. Increases in pulmonary pressure occur days to weeks

before clinical symptoms are seen and may even persist after resolution of symptoms.^{9,11,12} Measuring intrathoracic impedance by using an implantable device has been shown to be effective in early detection of heart failure and reduce hospitalization and mortality.¹⁰ With this method, the impedance is measured between the coil of right ventricular lead and the defibrillator can. It uses a low level electric impulse that travels across the chest cavity and measures the resistance.⁶ The measurement is made multiple times every day, as the fluid level increases intrathoracic impedance falls.²

The OptiVol index represents the difference between daily fluctuations and reference impedance (index increases as fluid accumulates).⁷ The OptiVol index may be superior and sensitive to fluid change and more reliable in detecting decompensated heart failure.¹³⁻¹⁵ The Medtronic Impedance Diagnostic in Heart Failure trial (MID-HeFT) study, the first of this kind, found that the OptiVol index was higher in patients with symptoms of heart failure and allowed timely intervention decreasing the cost of hospitalization.¹³ Similarly, the Fluid Accumulation Status Trial (FAST) and Program to Access and Review Trending Information and Evaluate Correlation to Symptoms in Patients With Heart Failure (PARTNERS HF)^{14,15} trial showed that changes in fluid index derived from intrathoracic impedance was a more accurate indicator of heart failure than daily

weight monitoring and could predict worsening heart failure in advance.¹⁵ However, daily impedance can be affected by various factors like pleural/pericardial effusion, pneumonia (where the impedance decreases), pneumothorax (where the impedance increases), or any condition that increases intra-abdominal pressure, which will push the diaphragm up causing an increase in intrathoracic pressure and a decrease in impedance (producing a false positive reading).¹⁶ Therefore the patient data, history, and medications should be taken in to account when utilizing OptiVol index to assist in patient management.

We present a case of pulmonary congestion due to rapid atrial fibrillation

(AF) detected pre-clinically with OptiVol index.

Case Report

A 70-year-old female presented for a regular office visit. She had a Biventricular Implantable Cardioverter Defibrillator (BiV-ICD) for severe left ventricular dysfunction and left bundle branch block. She complained of non-specific fatigue for several weeks. Upon further interrogation, the fatigue coincided with some dietary indiscretion during the Christmas season. She was on a diet at that time. There was an increase in the OptiVol fluid index (see Figure 1) which was followed by atrial fibrillation (AF). The occurrence of AF led

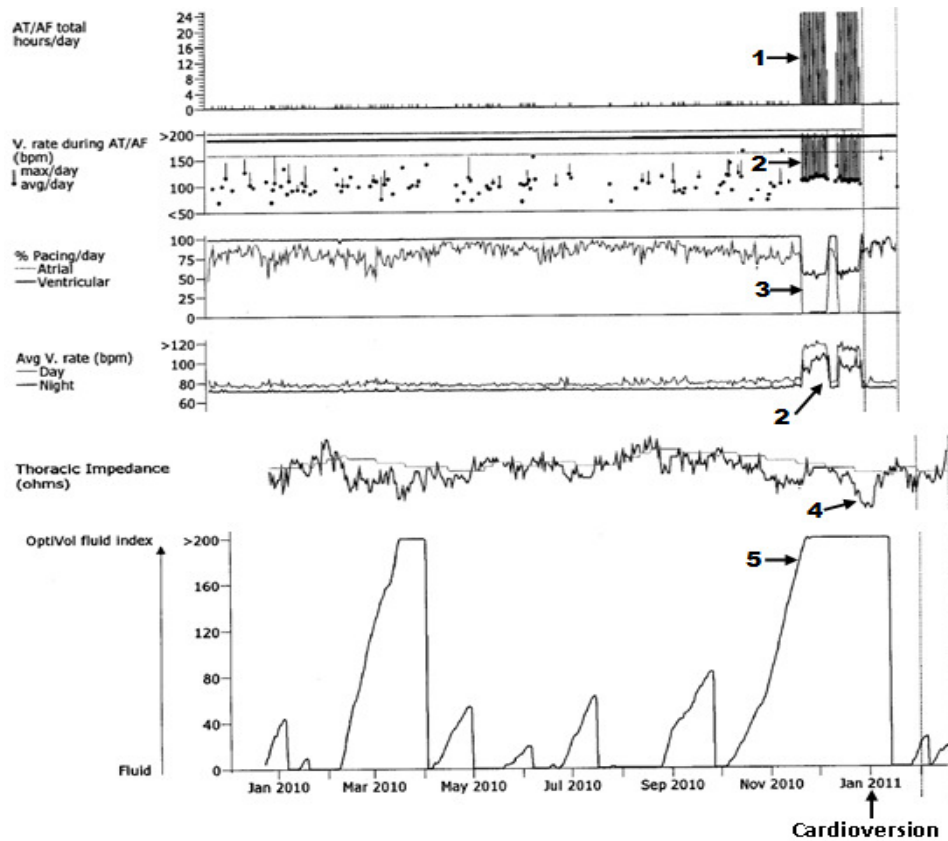


Figure 1. Initial interrogation: cardiac compass trends. 1. Atrial fibrillation. 2. High ventricular rate. 3. Diminished pacing due to atrial fibrillation. 4. Decreasing thoracic impedance. 5. Increasing fluid buildup.

to a rapid ventricular response and absent atrial pacing. The ventricular pacing also increased in duration and rate. She was cardioverted with resolution of symptoms. The OptiVol index returned to baseline.

Discussion

This case graphically demonstrated some of the cardinal pathophysiological mechanisms leading to pulmonary edema and its “preclinical” recognition by the BiV-ICD device. First, the patient indulged in a high salt meal, which increased left atrial pressure, thus precipitating atrial fibrillation.

AF caused a rapid ventricular rate which increased left ventricular filling pressures and poor left ventricular filling. Ineffective atrial emptying increased back pressure towards pulmonary capillaries perpetuating the problem. Finally, she had more ventricular pacing which likely made the ventricle more dyssynchronous. All of these factors increased filling pressure on the left ventricle and left atrium giving rise to a perpetuating pulmonary edema which increased OptiVol index. Removal of rich food alone did not take care of her problem. Electrical cardioversion did.

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