

Time-to-Decongestion Following Heart Failure Hospitalization as Measured by Extracellular Fluid Nadir Using Bioimpedance Spectroscopy



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Summary

Introduction: Patients hospitalized with acute decompensated heart failure are at high risk for readmission, morbidity, and mortality. Evaluating volume status remains a challenge to most practitioners. Resolution of symptoms, weight monitoring, and peripheral edema are not always true indicators of a patient's current volume status. Following heart failure (HF) hospitalization, patients often are discharged on an increased diuretic regimen with uncertainty around how long it will take for a patient to reach true decongestion. Bioimpedance Spectroscopy (BIS) has been shown to accurately measure extracellular fluid (ECF) and correlates well with bromide dilution (gold standard method).

Clinical Study: Patients with NYHA Class II or III HF were enrolled in a multi-center observational study. Initial BIS measurement and body weight was obtained 48-72 hours following HF hospital discharge and measured daily thereafter. We report on 69 patients each of whom had between 30 and 90 days of monitoring post-discharge. Daily ECF and weight results were not made available to treating providers.

Findings: Time-to-ECF nadir was 16.9 ± 15.9 days (mean ± SD), range 0 to 62.9 days. ECF loss from initial measurement to nadir was 2.2 ± 1.9 liters, range 0 to 9.65 liters; ECF loss on a percentage basis was 10.3% ± 7.4%, range 0% to 32.6%. Time to weight nadir was 18.1 ± 15.5 days, range 0 to 49.9 days. Weight loss from initial measurement to nadir was 3.6 ± 3.9 kg, range 0 to 18.5 kg. Weight loss on a percentage basis was 4.5% ± 5.1%, range 0% to 28.7% and was significantly lower than the corresponding measure for ECF [median weight loss of 3.4% (95% CI: 2.1-4.2%) versus median ECF loss of 7.8% (95% CI: 6.7-10.4%), p<0.0001 by Wilcoxon test].

Discussion: The time required to achieve clinical decongestion is highly variable and often takes longer than may be anticipated; in our study it took an average of 16.9 days. Our results show that ECF is more sensitive than weight when tracking post-discharge decongestion. Noninvasive BIS measurements may assist clinicians with tracking fluid status in HF patients. ECF monitoring during the weeks following heart failure hospitalization may provide a more accurate measure of fluid status than weight alone.

The more than two-fold ECF loss as compared to weight loss on a percentage basis (P<0.0001) demonstrates the sensitivity of BIS during diuresis post-hospitalization.

Table 1: Patient Characteristics (N = 69)

Gender [n (%)]	F: 34 (49%) M: 35 (51%)				
	Mean ±	SD	Median	Min	Max
Age (years)	69.8 ±	14.8	73.0	32.0	96.0
Monitoring (days)	46.1 ±	8.0	44.8	30.9	85.0
Weight (kg)	81.7 ±	21.0	79.2	42.9	153.0
BMI (kg/m ²)	29.2 ±	6.0	28.5	19.3	49.5
ECF (liters)	20.2 ±	5.9	19.8	8.7	38.3

Table 2: ECF vs Weight Loss

	Mean ±	SD	Median	IQR [^]
ECF Loss (liters)	2.2 ±	1.9	1.7	0.7, 3.1
ECF Loss (%)	10.3 ±	7.4	7.8 *	4.7, 14.7
Weight Loss (kg)	3.6 ±	3.9	2.5	0.8, 5.3
Weight Loss (%)	4.5 ±	5.1	3.4 *	1.2, 5.6

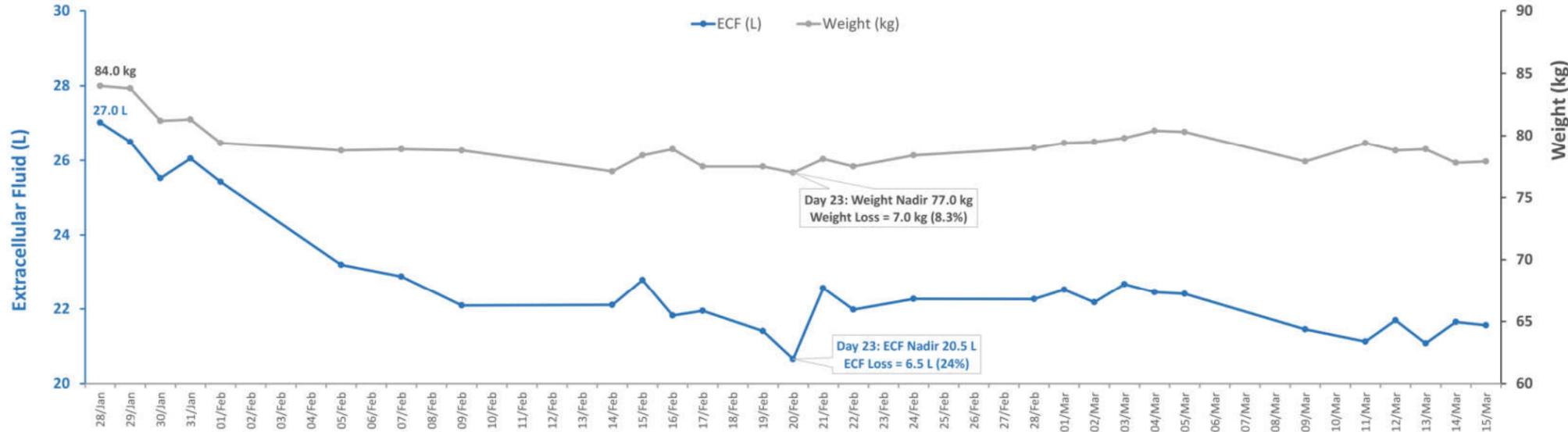
*P < 0.0001 by Wilcoxon test; [^]IQR: interquartile range

Figure 2: Study Device



BIS measurements were performed using the SOZO[®] device (ImpediMed Limited, Brisbane, Australia). The device measures the resistance and reactance at 256 frequencies from 3 to 1000 kilohertz (kHz). A measurement takes approximately 30 seconds and is performed at the point-of-care.

Figure 1: Case Study – 39 y/o Male, Time-to-Decongestion was 23 Days



Clinical Implications

- ECF is more sensitive than weight when tracking decongestion.
- BIS is a more sensitive method than weight to monitor fluid status in patients with heart failure.
- Time required to achieve clinical decongestion takes longer than may be anticipated.