Noninvasive Assessment of Lung Fluid Content in Heart Failure Patients

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Background

- Remote dieletric sensing (ReDS) is a method of measuring lung fluid content expressed as a percent of lung volume.
- It is currently being studied as a means of monitoring fluid status in heart failure patients.
- The correlation of ReDS readings with invasive hemodynamic measurements, including central venous pressure (CVP) and pulmonary capillary wedge pressure (PCWP) in heart failure patients is not known.

Aims

This study aimed to investigate the utility of ReDS readings in predicting volume status and its correlation to invasive hemodynamics in heart failure patients.

Methods

- We prospectively enrolled heart failure patients undergoing clinically indicated right heart catheterization.
- Baseline demographic characteristics, laboratory data and hemodynamics were collected.
- Concomitant ReDS readings were obtained immediately prior to catheterization.
- Correlation of ReDS readings with PCWP were assessed with Pearson coefficients.
- The sensitivity and specificity of determining elevated filling pressures (indicative of fluid overload) were assessed using receiver operating characteristic (ROC) curve analysis.

Results

Table 1. Baseline characteristics

	N=159
Age, yr	**54.9±13.3**
Gender (Male)	**108(67.9%)**
Race	
Caucasian	**89(56%)**
African American	**57(35.8%)**
Hispanic	**8(5.0%)**
ICM	**53(33.3%)**
DM	**57(35.8%)**
HTN	**104(65.4%)**
PAD	**6(3.8%)**
Afib	**43(27.0%)**
History of VT	**38(23.9%)**
COPD	**9(5.7%)**
BMI	**29.2±5.58**
OSA	**34(21.4%)**

Table 2. Univariate and Multivariate Analysis

	Univariate		Multivariate			
	B	**P**	**B**	**P**	**B**	**P**
CVP	**0.031**	**<0.001**	**-0.005**	**0.991**		
mPAP	**0.021**	**<0.001**	**0.007**	**0.279**		
PCWP	**0.031**	**<0.001**	**0.019**	**0.032**	**0.030**	**<0.001**
CI	**-0.224**	**<0.001**	**-0.101**	**0.057**		

Results

Figure 1A.

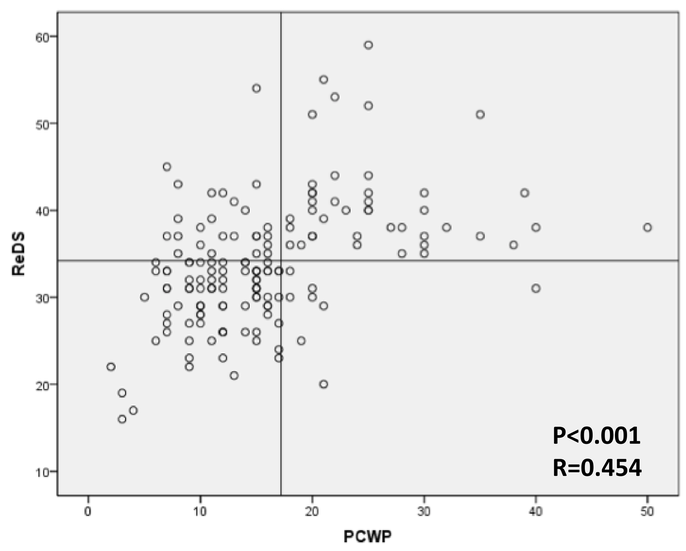
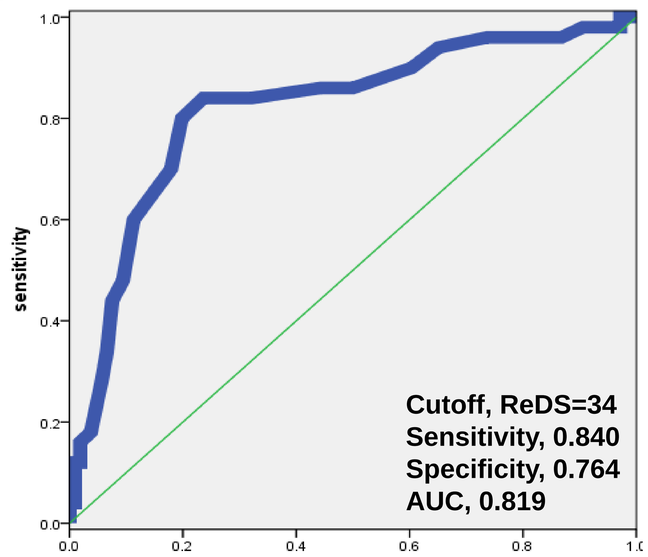


Figure 1B.



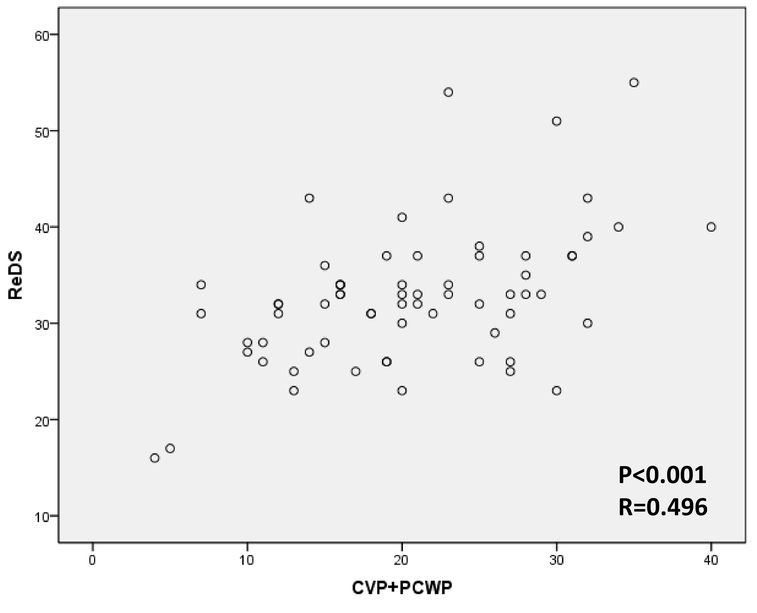
A) Pearson's correlation of ReDS values with PCWP.

B) ROC analysis revealed that a ReDS value >35 predicts a PCWP of >18 with a sensitivity of 84.0% and specificity of 76.4% and NPV of 91.0%.

Table 3.

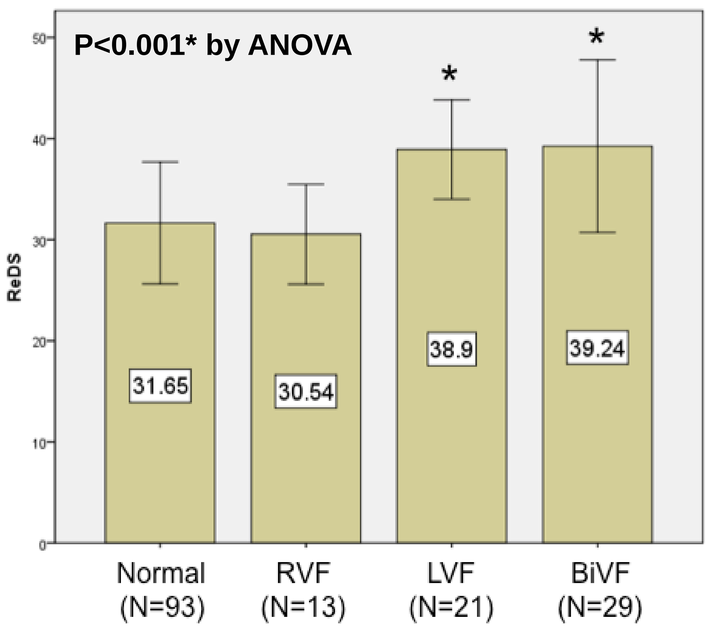
	Disconcordant (N=33)	Concordant (N=123)	P value
Demographics			
Age, yr	51.5±13.6	55.7±13.3	0.107
BMI	32.6±5.2	28.4±5.3	<0.001*
Gender (Male)	20 (60%)	88 (72%)	0.159
Race			
Caucasian	15 (46%)	71 (58%)	0.724
African american	16 (48%)	41 (33%)	0.412
Hispanic	1 (3%)	7 (6%)	0.715
Others	1 (3%)	4 (3%)	0.213
ICM	8 (24%)	43 (35%)	0.197
DM	15 (45%)	42 (34%)	0.160
HTN	22 (67%)	80 (65%)	0.518
PAD	0 (0%)	5 (4%)	0.299
Afib	10 (30%)	32 (26%)	0.386
History of VT	7 (21%)	30 (24%)	0.450
COPD	1 (3%)	7 (6%)	0.502
OSA	6 (9%)	25 (20%)	0.444
HTx	13 (39%)	53 (43%)	0.430
Hemodynamics			
CVP, mmHg	9.2±4.3	9.2±6.2	0.989
mPAP, mmHg	25.8±7.7	27.5±11.8	0.312
PCWP, mmHg	14.5±6.2	16.4±8.6	0.164
CI, L/min/m2	2.77±0.58	2.71±0.71	0.642
ReDS	36.5±6.2	33.3±7.4	0.023*

Figure 3.



Pearson's correlation of ReDS values with combined CVP+PCWP.

Figure 2.



Normal: CVP < 12 and PCWP < 18mmHg
RVF: CVP >12 and PCWP < 18
LVF: CVP < 12 and PCWP ≥ 18
BiVF: CVP >12 and PCWP ≥ 18

Limitations

- Single center study

Conclusions

- Lung fluid content measured by ReDS correlated with R=0.454 to invasively measured PCWP.
- The negative predictive value of a ReDS value of <35 was 91.0%.
- ReDS values were significantly different across different hemodynamic profiles.

Disclosures

NU is consultant for St Jude and Medtronic. DB is consultant for Sensible Medical Innovations. AA is employed by Sensible Medical Innovations.