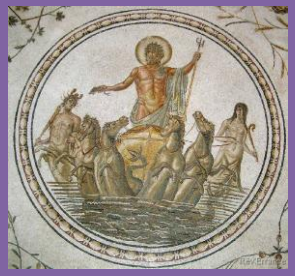

How to improve time to first diagnosis in Acute Heart Failure

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Improving the Diagnosis of Acute Heart Failure Using a Validated Prediction Model

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Toronto, Ontario, Canada; and Boston, Massachusetts

Table 1 Distribution of Cases Relative to Pre-Test Probability

Pre-Test Probability of AHF (Group)	Adjudication Diagnosis		
	AHF	No AHF	Total
≤20%	26 (16.0	137 (84.0)	163 (33.7)
21%–79%	80 (43.5)	104 (56.5)	184 (38.1)
≥80%	115 (84.6)	21 (15.4	136 (28.2)
Total	221 (45.8)	262 (54.2)	483 (100)

Values are n (%).
AHF = acute heart failure.

AHF presentation

TOO FAST

Acute coronary syndrome
Arrhythmia
High blood pressure…

PROGRESSIVE

CHF Decompensation

+ **Clinical challenge** **+++**

When early is early ?

PAWP + TFC↑

Fatigue

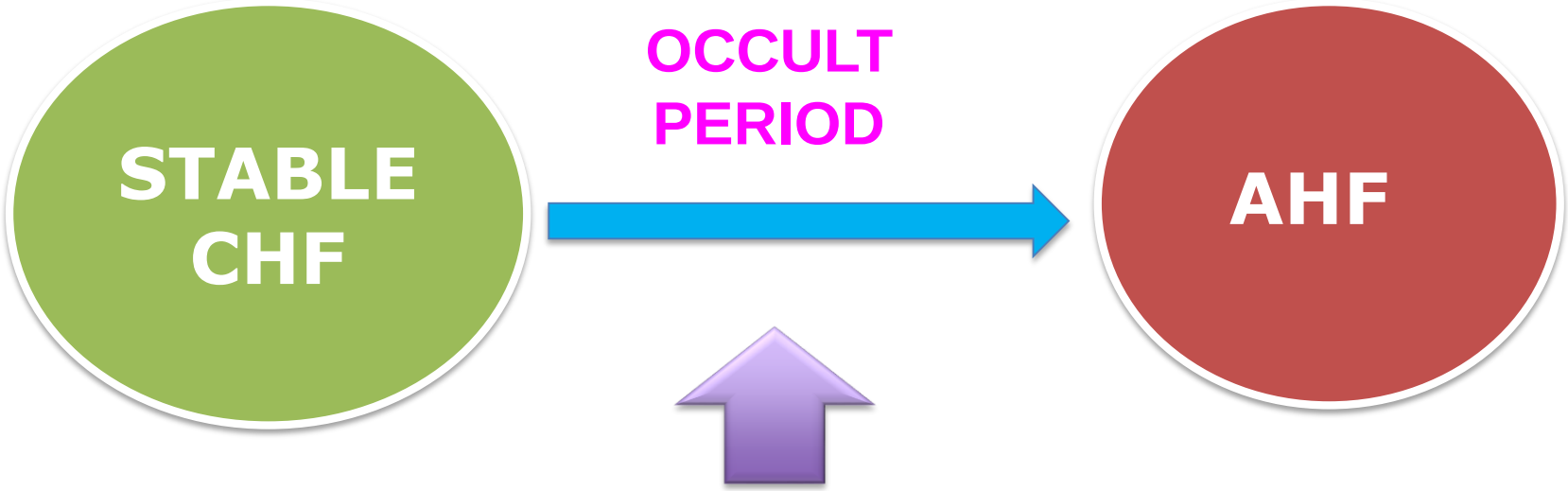
Weight gain

Dyspnea

STABLE CHF

AHF

Why early diagnosis of AHF is a clinical challenge ?



When the patient reachs the hospital

STABLE CHF

AHF

Diagnostic errors 20 %

Finding	Sensitivity	Specificity	Summary LR (95% CI) Positive	Negative
Medical history				
Heart failure	0.60	0.90	5.8 (4.1-8.0)	0.45 (0.38-0.53)
Myocardial infarction	0.40	0.87	3.1 (2.0-4.9)	0.69 (0.58-0.82)
Coronary artery disease	0.52	0.70	1.8 (1.1-2.8)	0.68 (0.48-0.96)
Hypertension	0.60	0.56	1.4 (1.1-1.7)	0.71 (0.55-0.93)
Symptoms				
Paroxysmal nocturnal dyspnea	0.41	0.84	2.6 (1.5-4.5)	0.70 (0.54-0.91)
Orthopnea	0.50	0.77	2.2 (1.2-3.9)	0.65 (0.45-0.92)
Dyspnea on exertion	0.84	0.34	1.3 (1.2-1.4)	0.48 (0.35-0.67)
Physical examination				
Third heart sound	0.13	0.99	11.0 (4.9-25.0)	0.88(0.83-0.94)
Jugular venous distension	0.39	0.92	5.1 (3.2-7.9)	0.66 (0.57-0.77)
Rales	0.60	0.78	2.8 (1.9–4.1)	0.51 (0.37–0.70)
Any murmur	0.27	0.90	2.6 (1.7–4.1)	0.81 (0.73–0.90)
Lower extremity edema	0.50	0.78	2.3 (1.5–3.7)	0.64 (0.47–0.87)
Wheezing	0.22	0.58	0.52 (0.38–0.71)	1.3 (1.1–1.7)
Chest radiograph				
Pulmonary venous congestion	0.54	0.96	12.0 (6.8–21.0)	0.48 (0.28–0.83)
Interstitial edema	0.34	0.97	12.0 (5.2–27.0)	0.68 (0.54–0.85)
Alveolar edema	0.06	0.99	6.0 (2.2–16.0)	0.95 (0.93–0.97)
Cardiomegaly	0.74	0.78	3.3 (2.4–4.7)	0.33 (0.23–0.48)
Pleural effusion	0.26	0.92	3.2 (2.4–4.3)	0.81 (0.77–0.85)
12-Lead electrocardiogram				
Atrial fibrillation	0.26	0.93	3.8 (1.7–8.8)	0.79 (0.65–0.96)
New T-wave changes	0.24	0.92	3.0 (1.7–5.3)	0.83 (0.74–0.92)
Any abnormal finding	0.50	0.78	2.2 (1.6–3.1)	0.64 (0.47–0.88)

Sam L et al. *Crit Pathways* in Cardiol 2015

How to reduce diagnostic inaccuracy ?

False positive
+++

Congestion signs
- Legs swell (pitting Edema)
- Neck veins distend (JVD)
- Liver congestion (Hepato Jug Rflx)
- Lung congestion (Rales)

Signs with negative LR

False negative
+

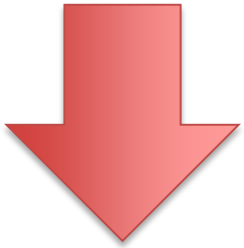
Low Organ perfusion signs
- Narrow pulse pressure
- Fatique
- Cool extremities
- Hypotension
- Renal dysfunction

Signs with positive LR

How to reduce diagnostic inaccuracy ?

USE OF SCORES ?

Available clinical scores



Stable

CHF

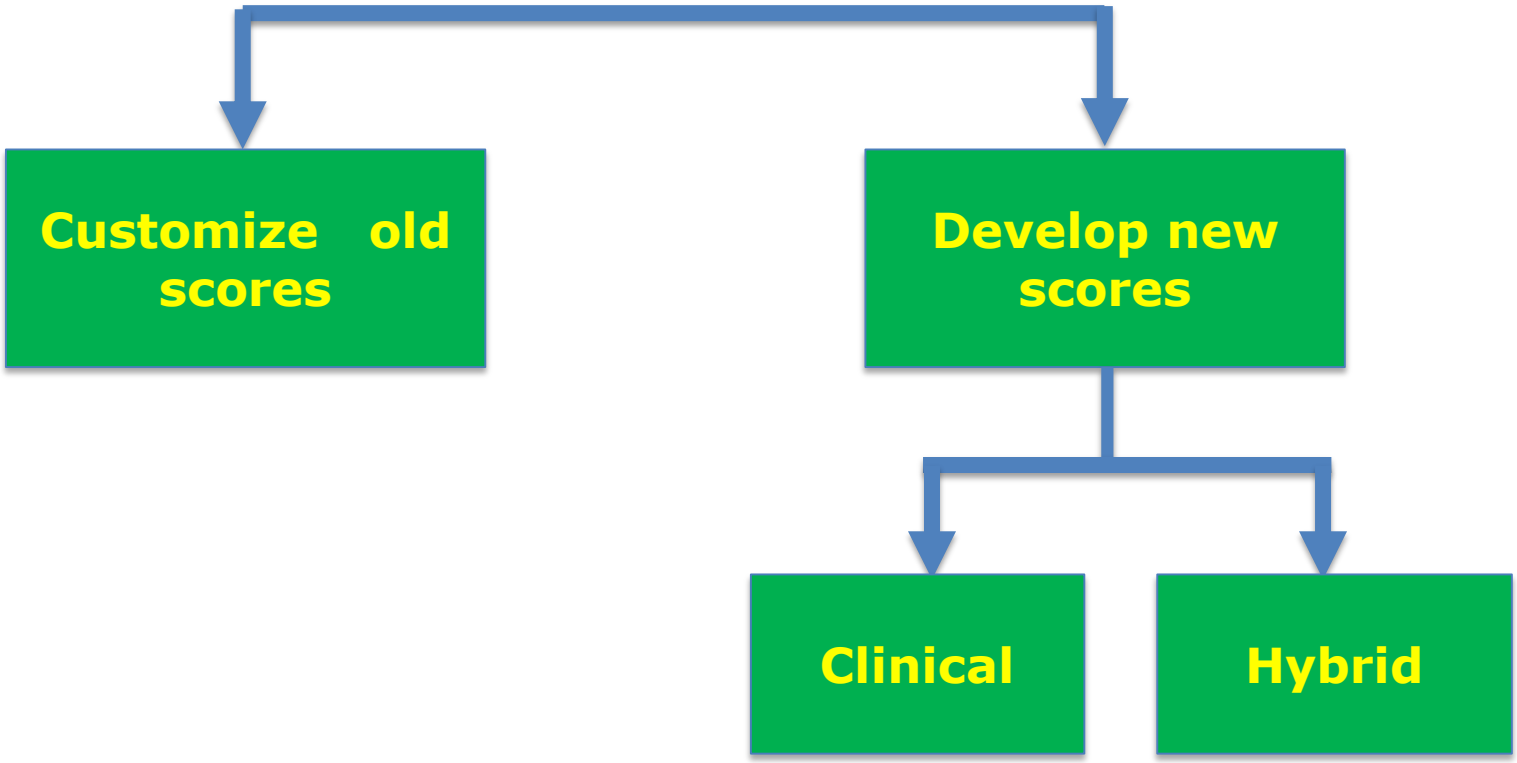
Diagnostic performance of HF scoring systems

Scoring System	Sensitivity	Specificity
Framingham	63%±4%	94%±1%
Boston*	35%±4%	99%±0%
NHANES	62%±4%	94%±1%
Gheorghiade	55%±4%	95%±1%

NHANES, National Health and Nutrition Examination Survey.
*Test characteristics for a Boston Score greater than 8.

Collins et al, Ann Emerg Med.2008

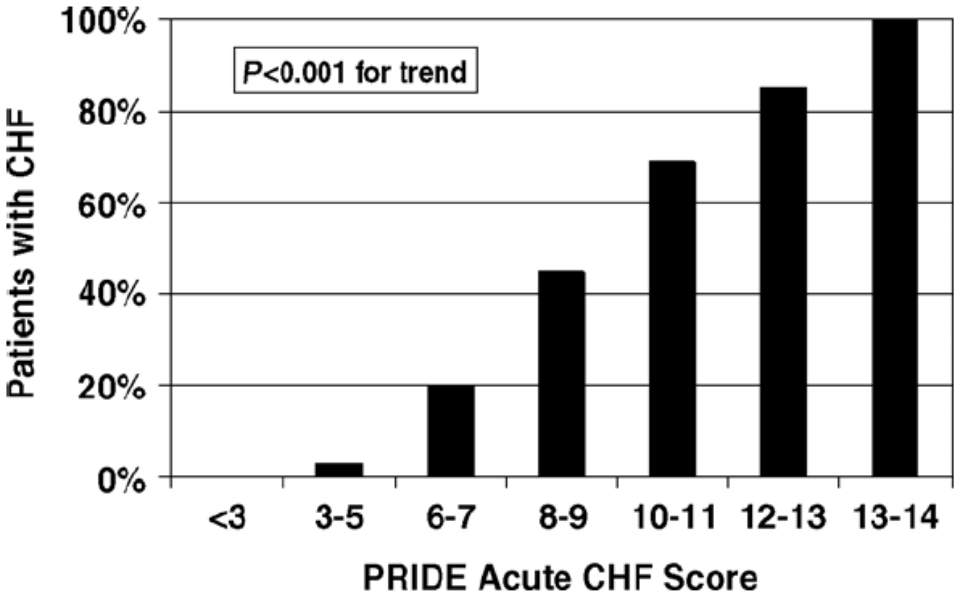
Develop AHF specific scores



A validated clinical and biochemical score for the diagnosis of acute heart failure: The ProBNP Investigation of Dyspnea in the Emergency Department (PRIDE) Acute Heart Failure Score

Aaron L. Baggish, MD,[a] Uwe Siebert, MD, MSc, MPH,[b] John G. Lainchbury, MD,[d] Renee Cameron, MS,[a] Saif Anwaruddin, MD,[a] Annabel Chen, MD,[a] Daniel G. Krauser, MD,[a] Roderick Tung, MD,[a] David F. Brown, MD,[c] A. Mark Richards, MD, PhD,[d] and James L. Januzzi Jr, MD[a] *Boston, MA; and Christchurch, New Zealand*

Predictor	Point value
Elevated NT-proBNP*	4
Interstitial edema on CXR	2
Orthopnea	2
Lack of fever	2
Curruent loop diuretic use	1
Age >75 y	1
Rales on lung exam	1
Lack of cough	1



Am Heart J 2006

Peak Flow

CHEST ONLINE

Clinical diagnosis of congestive heart failure in patients with acute dyspnea.

P R Marantz, M C Kaplan and M H Alderman

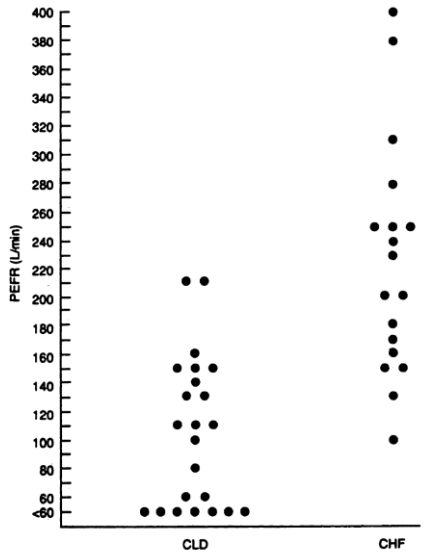


FIGURE 1. Peak expiratory flow rate (PEFR) values.

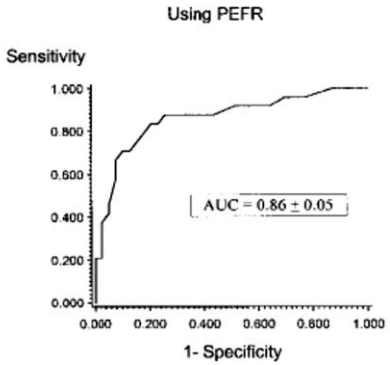
Chest 1990

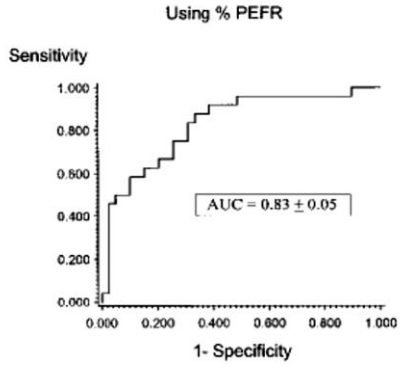
preliminary report

Dyspnea Differentiation Index*

A New Method for the Rapid Separation of Cardiac vs Pulmonary Dyspnea

Rajesh K. Ailani, MD; Keyvan Ravakhah, MD; Bruno DiGiovine, MD; Gordon Jacobsen, MS; Thaw Tun, MD, MRCP; Donald Epstein, MD, FCCP; and Burton C. West, MD

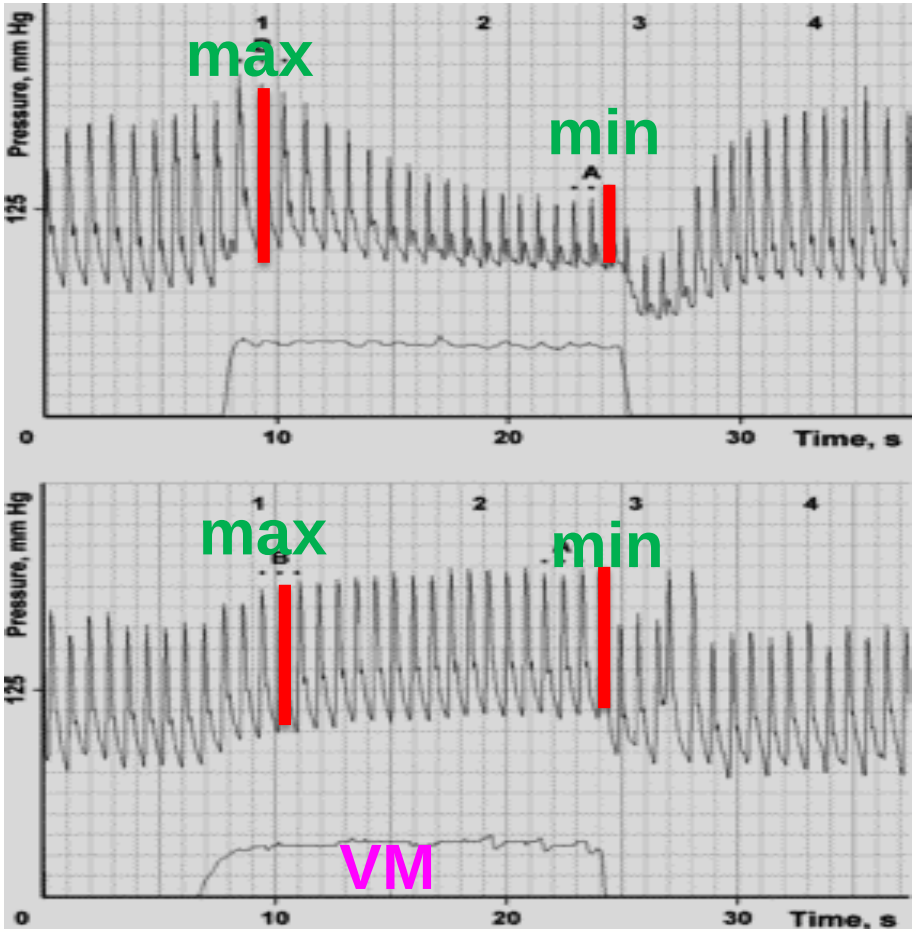




Chest 1999

Valsalva Maneuver
Pulse Amplitude Ratio (PAR)

$$PAR = \frac{\text{min PP}}{\text{max PP}}$$



Normal

PAR >70%

HF

HF

Finger photoplethysmography during the Valsalva maneuver reflects left ventricular filling pressure

Harry A. Silber,[1] Jeffrey C. Trost,[1] Peter V. Johnston,[1] W. Lowell Maughan,[1] Nae-Yuh Wang,[2] Edward K. Kasper,[1] Thomas R. Aversano,[1] and David E. Bush[1]

[1]*Division of Cardiology, Department of Medicine, Johns Hopkins University School of Medicine, Baltimore, Maryland; and*
[2]*Division of General Internal Medicine, Department of Medicine, Johns Hopkins University School of Medicine, Baltimore, Maryland*

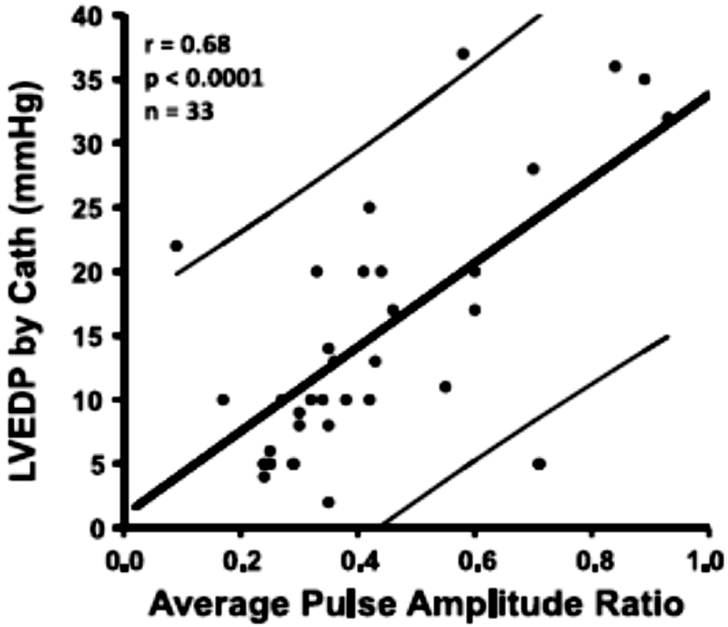


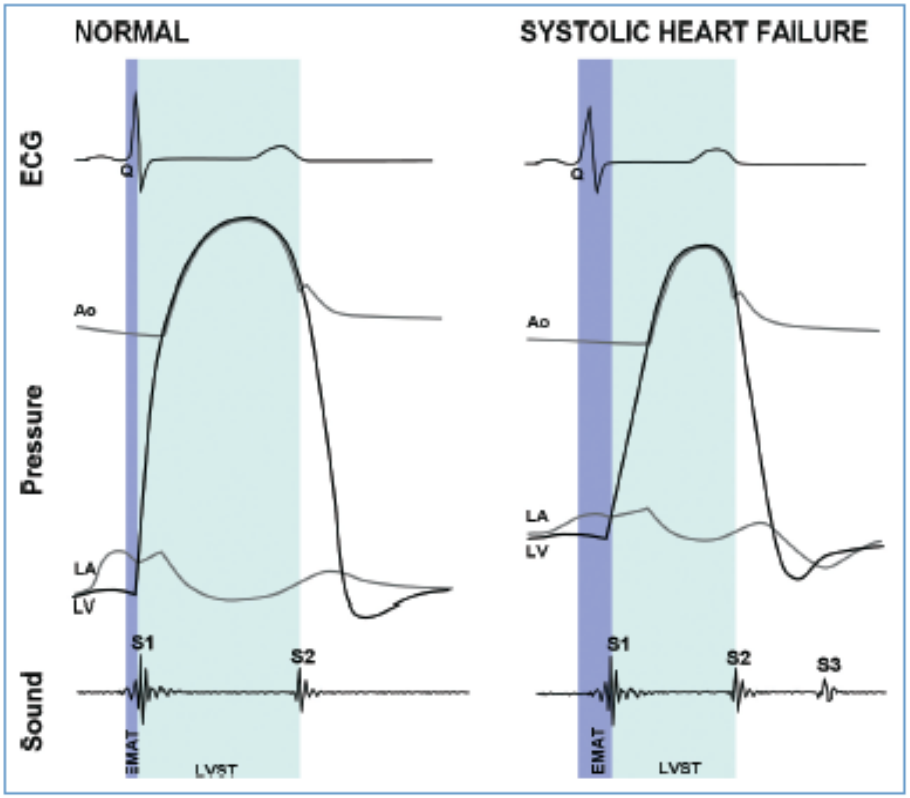
Fig. 3. Pulse amplitude ratio (PAR) measured from the PPG waveforms vs. subsequently measured LVEDP from cardiac catheterizations. Thinner, slightly concave lines indicate confidence intervals of the point.

Am J Physiol Heart Circ Physiol 2012

Acoustic cardiography

Acoustic cardiography

Parameter	Definition	Correlating Hemodynamic Parameters
S3 Strength	Overall acoustic energy of third heart sound. Range 0 – 10 units	S3 Strength >5 correlates with LVEDP >15mmHg
EMAT (Electro-mechanical activation time)	Duration from the onset of the QRS complex to the closure of the mitral valve	Shortened EMAT correlates with improved LV function
LVST (Left ventricular systolic time)	Time between mitral valve closure (S1) to the aortic valve closure (S2)	Lengthened LVST correlates with improved LV function



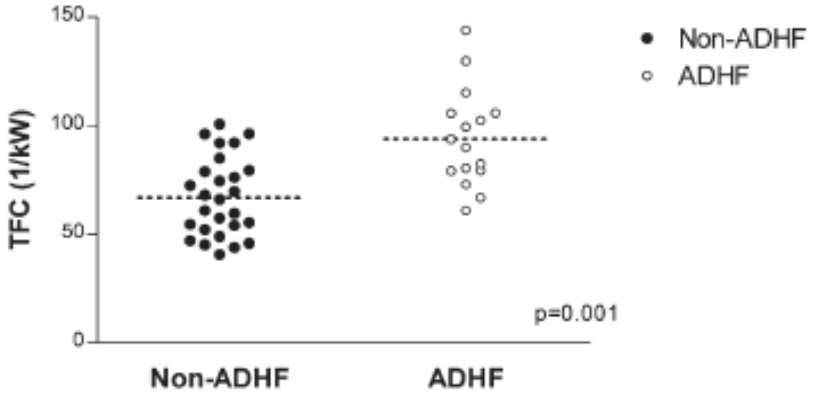
Acoustic cardiography

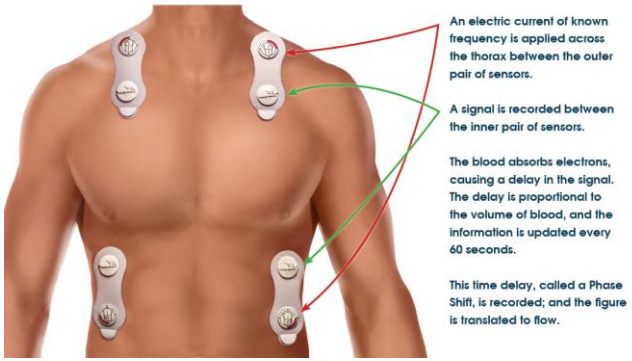
In favor of AHF

- Strength of S_3> 5
- EMAT increase
- LVST decrease

Thoracic Fluid Content

Noninvasive Assessment of Acute Dyspnea in the ED





Garcia X Chest 2013

Dynamic change of Cardiac Index

Hemodynamic changes as a diagnostic tool in acute heart failure—a pilot study☆,☆☆

Rakesh S. Engineer MD[a,*], Justin L. Benoit MD[a,c], Caitlin W. Hicks BA[a], Sunny J. Kolattukudy BS[a], Daniel Burkhoff MD, PhD[b], W. Frank Peacock MD[a]

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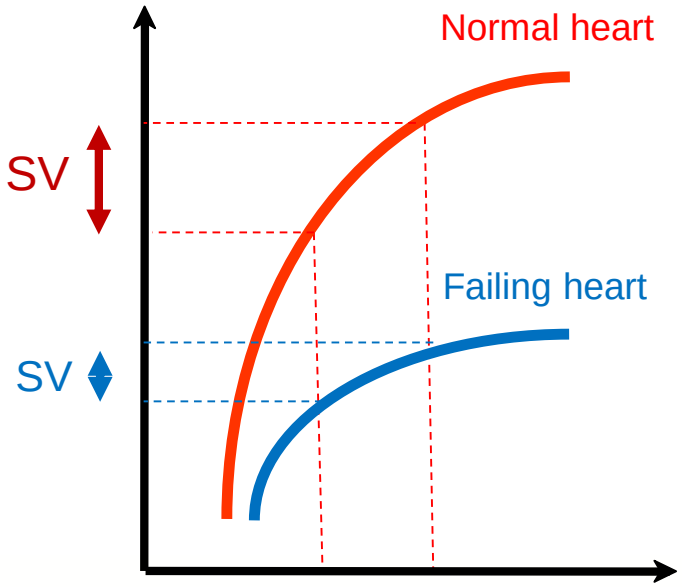

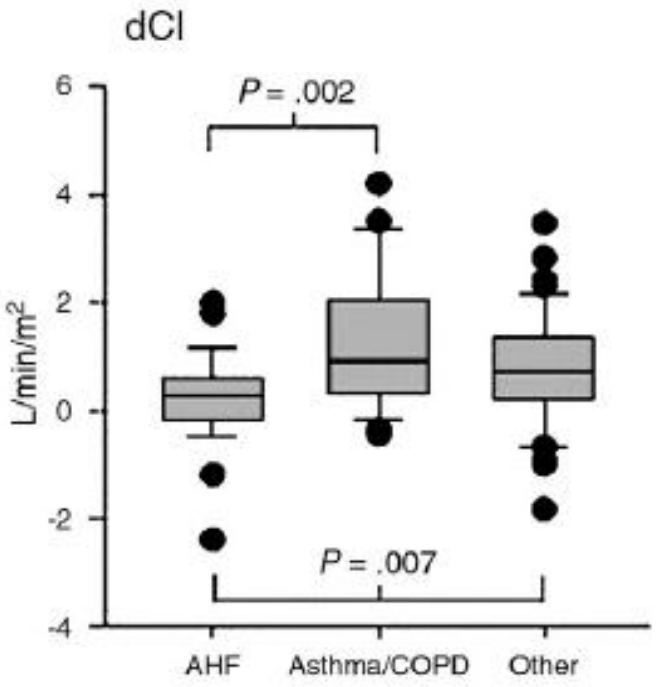

Am J Emerg Med 2012

CONCLUSION

How to improve time to first diagnosis in AHF ?