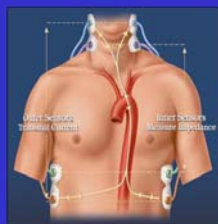# The clinical usability of impedance cardiography (ICG) in patients with acute exacerbation of systolic heart failure

Byung-su Yoo[1], Il-hyung Jung[1], Hee-sung Wang[1], Hyun-sook Jung[1], Jang-young Kim[1], Seung-hwan Lee[1], Sung-oh Hwang[2], Junghan Yoon[1], Kyung-hoon Choe[1]

[1]Department of internal medicine and [2]emergency medicine, Wonju College of Medicine, Yonsei University, Wonju, Korea

Impedance Cardiography (ICG)

- Current is Transmitted Through the Chest
- Current Seeks Path of Least Resistance: The Blood Filled Aorta
- ICG Measures the Baseline Impedance (Resistance) to this Current
- ICG Measures the Corresponding Change in Impedance

Impedance Cardiography (ICG)

Purpose

- We evaluate clinical usability of ICG parameters in patients with acute exacerbation of systolic heart failure (SHF).

Method : Inclusion criteria

- Between Feb 2004 and Aug 2004
- 34 patients with acute exacerbation (<1 month) of SHF on ER and 18 of normal persons
- Clinical evaluation ;
  Symptom, Sign (rales, S3 gallop)
  X-ray (Cardiomegaly, pulmonary edema, effusion)
  BNP (Biosite)
  Echocardiography

Method : ICG and Swan-Ganz

- Hemodynamic monitoring with BioZ ICG monitor (CardioDynamics, San Diego, CA) according to the manufacturer's guidelines.
- A data listing : stroke index (SI), cardiac index (CI), systemic vascular resistance index (SVRI), and total fluid content (TFC).
- In 8 of SHF patients, swan-ganz catheterization was performed invasively.
- Criteria for ICG-derived heart failure : either a CI ≤2.4 or STR≥0.55 concurrent with a CI <3.0L/min/m2.

Method : ICG Parameters

Measured Parameters	Calculated Parameters
- Thoracic Fluid Content (TFC)	- Stroke Volume / Index (SV/SI)
- Heart Rate (HR)	- Cardiac Output / Index (CO/CI)
- Acceleration Index (ACI)	- Systemic Vascular Resistance / Index (SVR/SVRI)
- Velocity Index (VI)	
- Pre-ejection Period (PEP)	- Left Cardiac Work / Index (LCW/LCWI)
- LV Ejection Time (LVET)	- Systolic Time Ratio (STR)

Results

- Mean age of total subjects (n=52) was 59.3±14 and male was 44.2% (n=23).
- In SHF group (n=34), mean age was 65.0±10.9, male was 41.2% and in control group (n=18), 48.4±13.1, male 50%.
- When pulmonary congestion was exist on plain chest film (n=23), ICG showed significantly higher value of TFC than heart failure patients without congestion (p=0.028).

Results: Comparison of hemodynamic profiles

	Control (n=18)	SHF (n=34)
Cardiac index (L/min/m2)	2.69±0.33	2.13±0.7
Thoracic Fluid Content (kOhm)	28.1±1.72	38.01±8.4
STR	0.32±0.04	0.47±0.2

STR : systolic time ratio
All datas were significant difference between the 2 groups (p<0.05)

Results: Accuracy of ICG

- Measured Cardiac Index (C I) in 8 Patients

Thermodilution vs. ICG

Correlation = 0.85

Precision = 0.24 l/min/m²

Bias = 0.09 l/min/m²

Thermodilution : via swan-ganz catheterization

Results

- There were significant relation between the data by ICG and swan-ganz catheterization in CI (r=0.85, p=0.030).
- In patients with SHF, there was significant correlation between EF and STR from ICG data (p=0.029, r=0.529).
- Diagnostic criteria for ICG-derived heart failure showed sensitivity 88.9%, specificity 60.0% in diagnosing SHF compare to echocardiography

Results : Volume status & systolic function
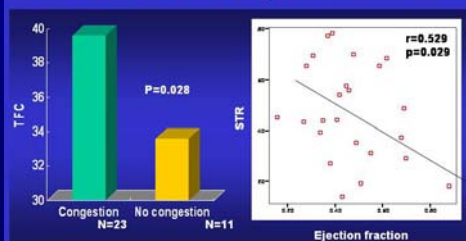
Conclusion

- We thought that ICG would be relatively useful method in differentiating SHF and provided useful information for hemodynamic parameters and volume status in patients with acute exacerbation of SHF.