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Non Invasive Hemodynamic Monitoring in the ED

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Is haemodinamic monitoring useful in the ED?

- Helps in diagnosis
- Gives information on disease progress
- Guides in adjusting therapy

società italiana medicina d'emergenza-urgenza

A.S.L. VC Azienda Sanitaria Locale di Vercelli

- Often, dyspnea poses a significant diagnostic challenge especially in patients with concurrent chronic lung disease and congestive heart failure.
- It is necessary to find an easy and cheap method to evaluate and monitor the hemodynamic status of the patient with dyspnea, in particular when the etiology may be difficult and the therapy may be highly influenced by the result.

Cardiac Output (CO)

Cardiac Output measurement gives information on heart function

Stroke Volume (SV) = EDV – ESV (vn 70-120 ml)
Ejection Fraction (EF) = (SV / EDV) × 100%
Cardiac Output (Q) = SV × HR

Measurement of CO may result extremely helpful in differentiating and monitoring outcome in undifferentiated dyspnea in the ED.

Bedside clinical evaluation of haemodynamic profile of the patient

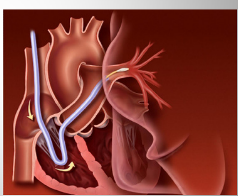
		Congestion at rest	
		NO	YES
Hypoperfusion at rest	NO	NORMAL Hot and Dry DISCHARGE	CPE Hot and Wet OBS/ADMIT
	YES	HYPOVOLEMIC SHOCK Cool and Dry OBS/ADMIT	CARDIOGENIC SHOCK Cool and Wet ADMIT/ICU

Classification by Stevenson et al. (Eur J Fail 1999)

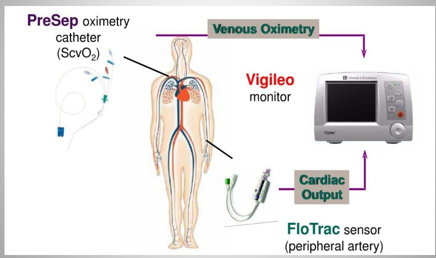
Invasive Hemodynamic Monitoring

Swan Ganz®

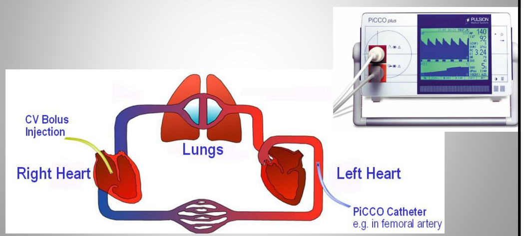
- Pulmonary artery cannulation
- 25 years experience
- Internal jugular vein puncture



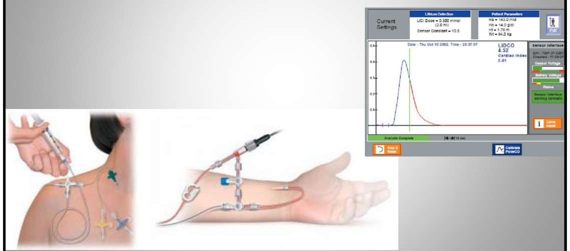
Invasive Hemodynamic Monitoring
VIGILEO®



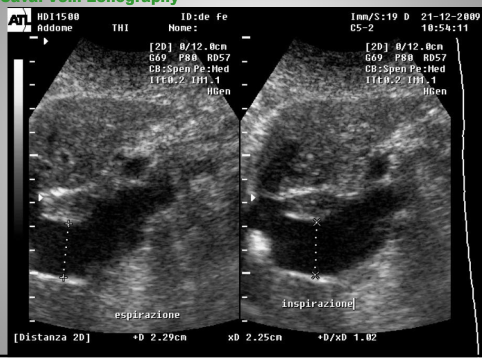
Invasive Hemodynamic Monitoring
PiCCO®

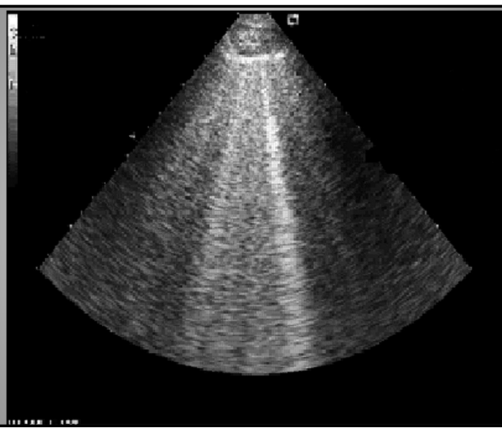


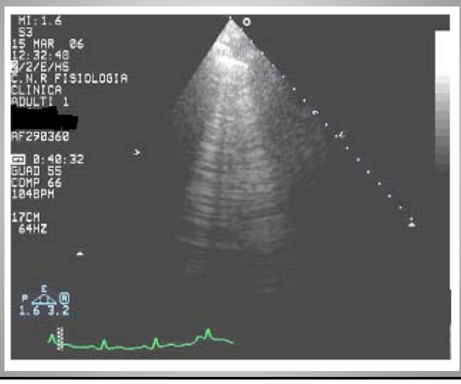
Invasive Hemodynamic Monitoring
LiDCO®

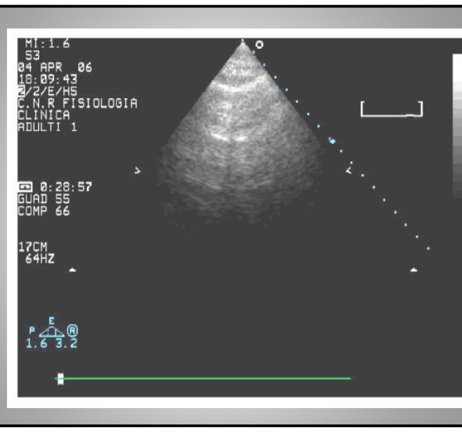


Non Invasive Hemodynamic Monitoring
Caval Vein Echography

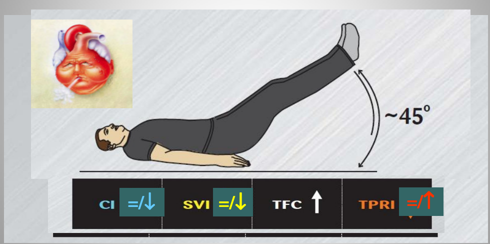








Non Invasive Hemodynamic Monitoring
Passive Leg Raising PLR



Marik *et al. Annals of Intensive Care* 2011, **1**:1
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REVIEW Open Access

Hemodynamic parameters to guide fluid therapy

Paul E Marik[1*], Xavier Monnet[2], Jean-Louis Teboul[2]

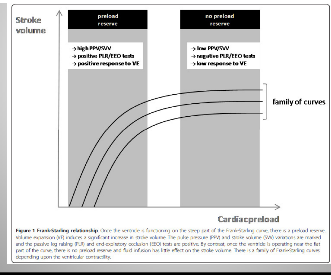


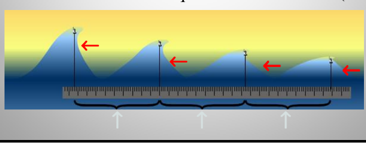
Figure 1 Frank-Starling relationship. Once the ventricle is functioning on the steep part of the Frank-Starling curve, there is a preload reserve. Volume expansion (VE) induces a significant increase in stroke volume. The pulse pressure (PPV) and stroke volume (SVV) variations are marked and the passive leg raising (PLR) and end-expiratory occlusion (EEO) tests are positive. By contrast, once the ventricle is operating near the flat part of the curve, there is no preload reserve and fluid infusion has little effect on the stroke volume. There is a family of Frank-Starling curves depending upon the ventricular contractility.

Non Invasive Hemodynamic Monitoring
Bioimpedence and Bioreactance

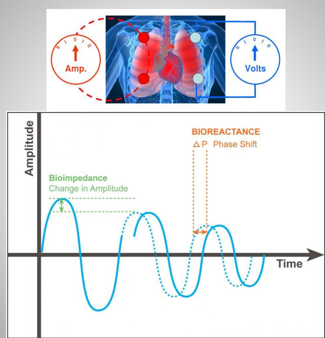
Both technologies are based on passage of low voltage current through the thorax

Bioimpedance measures the amplitude of the waves (AM ←)

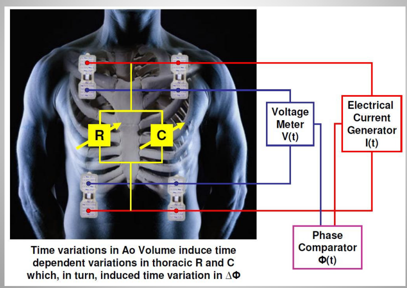
Bioreactance measures the frequence of the waves (FM)



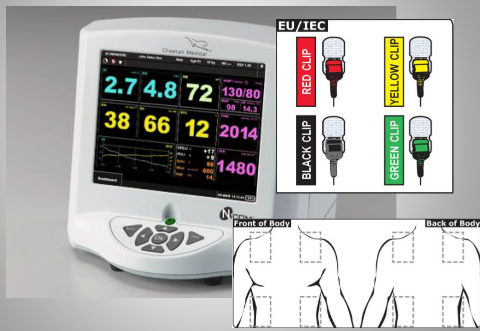
How Bioreactance works?



How Bioreactance works?



NICOM®



NICOM®: what does it measures?

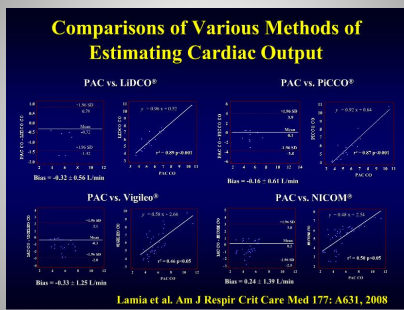
Direct measures

- HR
- CO, CI
- SV, SVI
- Systolic, Diastolic and Mean Blood Pressure
- Thoracic Fluid Content: TFC

Calculated data

- Total Peripheral Resistance TPRI
- DO2 (derived from Hct, SaO2)

Before and during Passive Leg Raising (PLR)



Practical applications of Non Invasive Hemodynamic Monitoring in the ED

Diagnosis

- AHF vs COPD

Therapeutic choice

- The patient is wet or dry?
- Fluid challenge evaluation (PLR)

Monitoring

- Treatment effect
- Dose adjustment
- Continuous emodynamic evaluation

- In patients with acute dyspnea, when a clear clinical doubt on the etiology, a useful tool for diagnosis e therapy monitoring is the evaluation of emodynamic status of the patient

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The COMET Protocol

- A pilot study on 20 patients with acute dyspnoea (SpO_2 <90% and/or P/F <250)
- Non invasive CO monitoring devices for differential diagnosis and monitoring of therapy response in patients with acute dyspnoea in the ED
- Objectives: to indagate the feasability of controlled trial to evaluate diagnostic sensibility and specificity of NICOM and thoracic US, alone and in combination, in patients with acute dyspnoea in the emergency setting

The COMET Protocol: methods

All patients are normally treated according to common therapeutic protocols for their supposed clinical diagnosis

At T0, 3 and 6 hours from admission, along with classical clinical monitoring (diuresis, thoracic objective exam, vitals), we perform:

- NICOM monitoring
- thoracic US
- BGA
- inferior vena cava collapse index (CCI)

The COMET Protocol: preliminary results

6 patients so far enrolled:

- No sensible improving of CO or CI neither in patients with acute cardiac failure (ACF) nor in respiratory patients
- Sensible reduction of Total Peripheral Resistance (TPR) and Total Peripheral Resistance Index (TPRI), as well as Thoracic Fluid Content (TFC) and its variation over time (TFCd), reflecting intrathoracic water, in patients with ACF clinically responding to treatment.
- Such findings seem to correlate with reduction in Thoracic US comet score and P/F improvement.

The COMET Protocol: potential further investigations

- To define and validate TFC and TPR normal values, which could be very useful, particularly when combined with thoracic US, in quick differential diagnosis between cardiac and respiratory acute dyspnoea
- To define and validate TPRI variations and TFCd to target in monitoring effectiveness of therapy in ACF patients

grazie

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