

25/05/2018



Regione Puglia

AZIENDA OSPEDALIERO-UNIVERSITARIA

CONSORZIALE POLICLINICO BARI

S.C. MEDICINA E CHIRURGIA DI ACCETTAZIONE E

URGENZA

Dir. Dr V. Procacci



XI congresso nazionale

simeu

ROMA 24-26 MAGGIO 2018

IL MONITORAGGIO CAPNOGRAFICO

NELL'INSUFFICIENZA RESPIRATORIA IPERCAPNICA

IN TRATTAMENTO CON NIMV

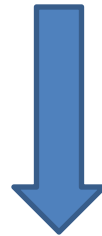
VITO PROCACCI

IRA o IRCR

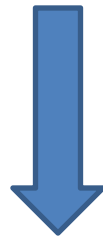


PaO₂ < 60 mmHg. (P/F<300) IPOSSIEMICO

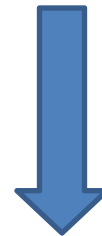
PaCO₂ > 45 mmHg. IPERCAPNICA



**DEFICIT MUSCOLARE
(PUMP -FAILURE)**

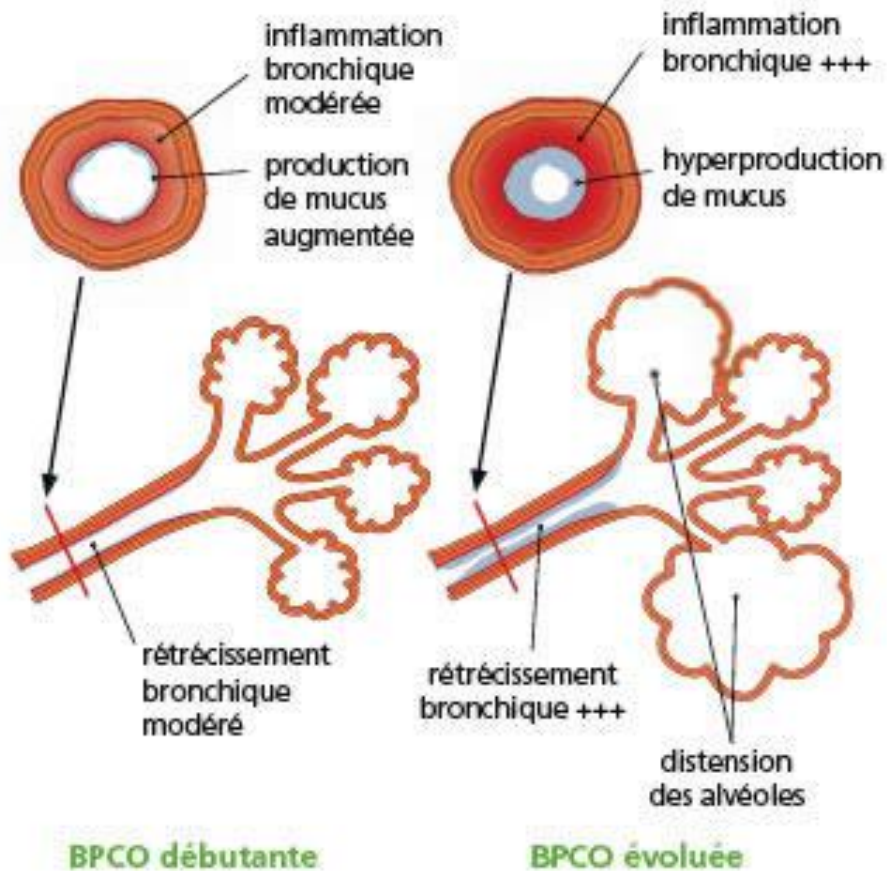


**DA ECCESSIVO CARICO
MECCANICO**



**DA RIDOTTA CAPACITA'
DELLA POMPA**

Fisiopatologia dell'IRA da BPCO



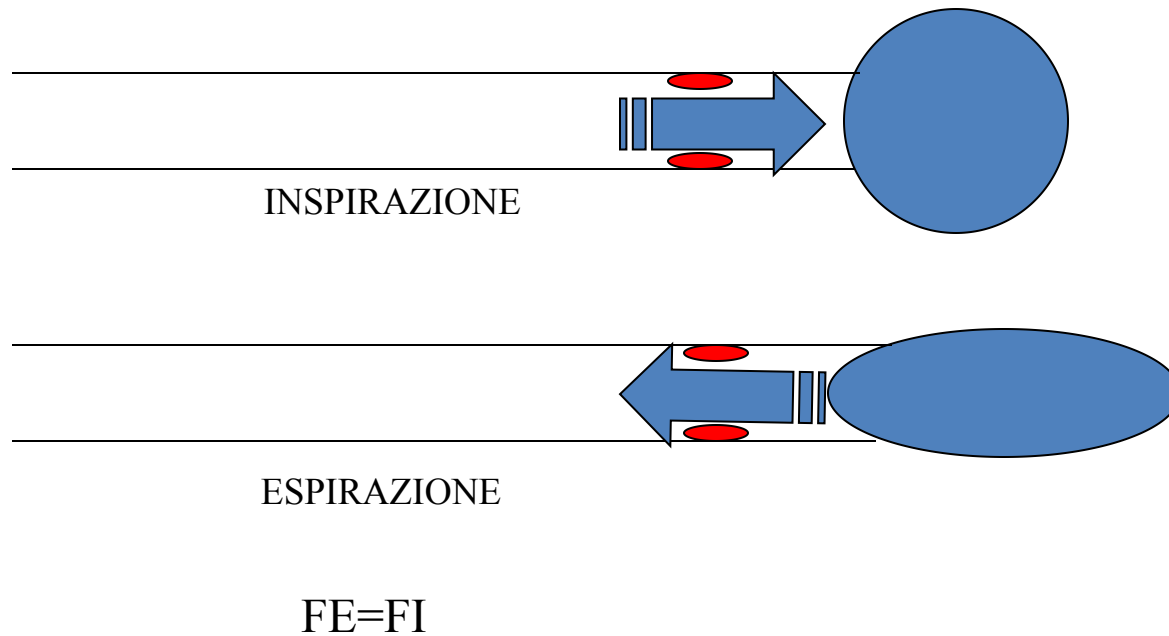
Alveoli with emphysema



Microscopic view of normal alveoli

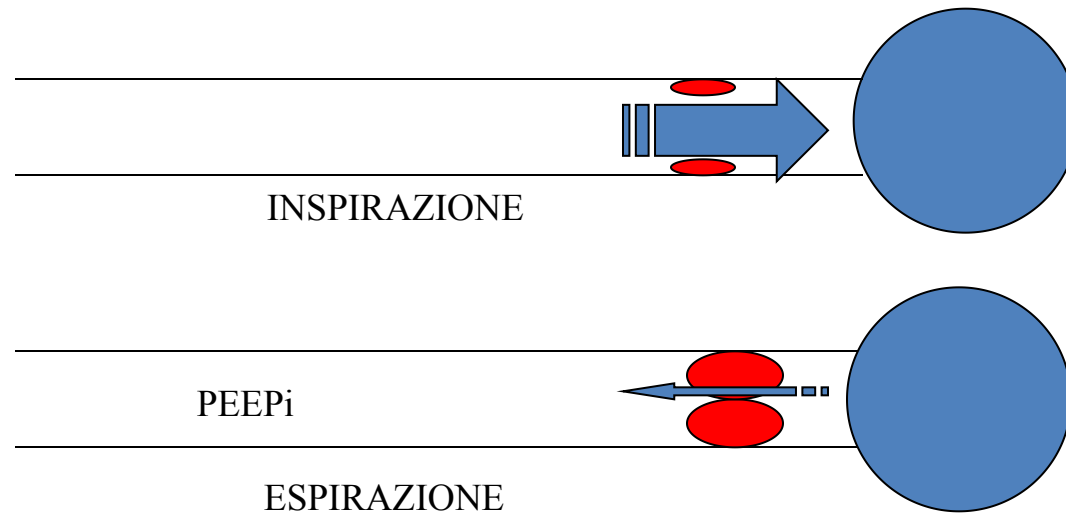


MECCANICA BRONCHIOLO-ALVEOLARE NORMALE



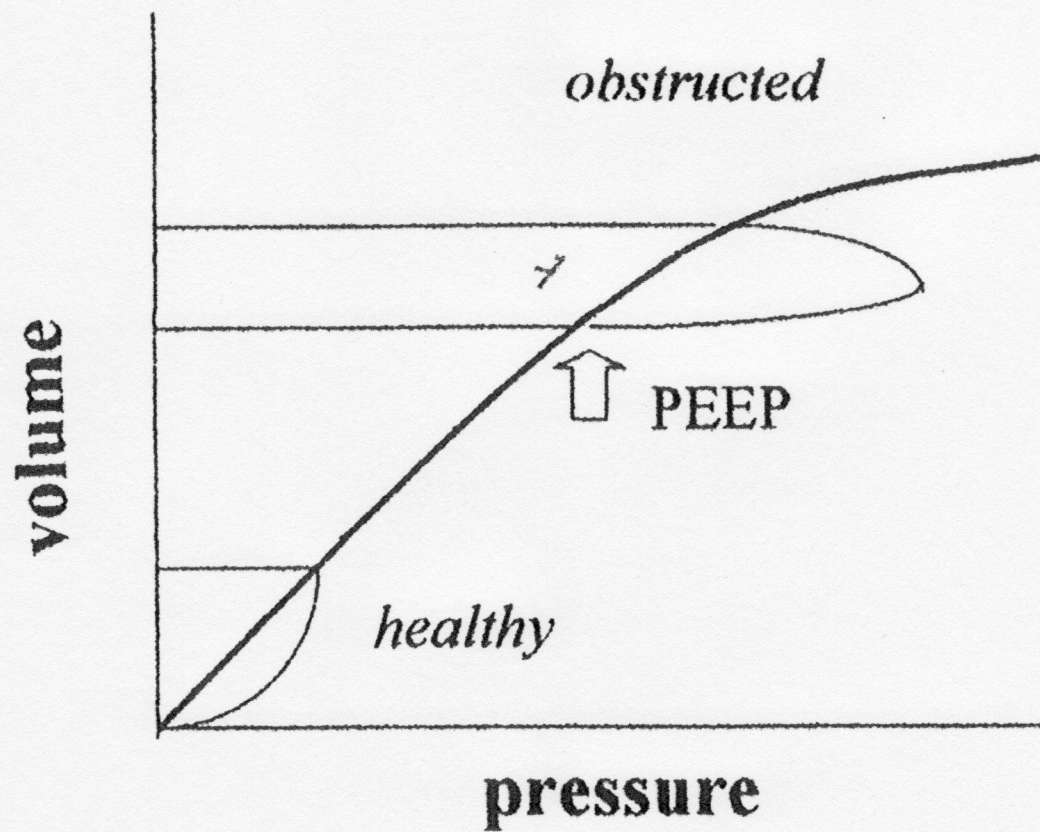
INSUFFICIENZA DI POMPA TORACICA

BPCO

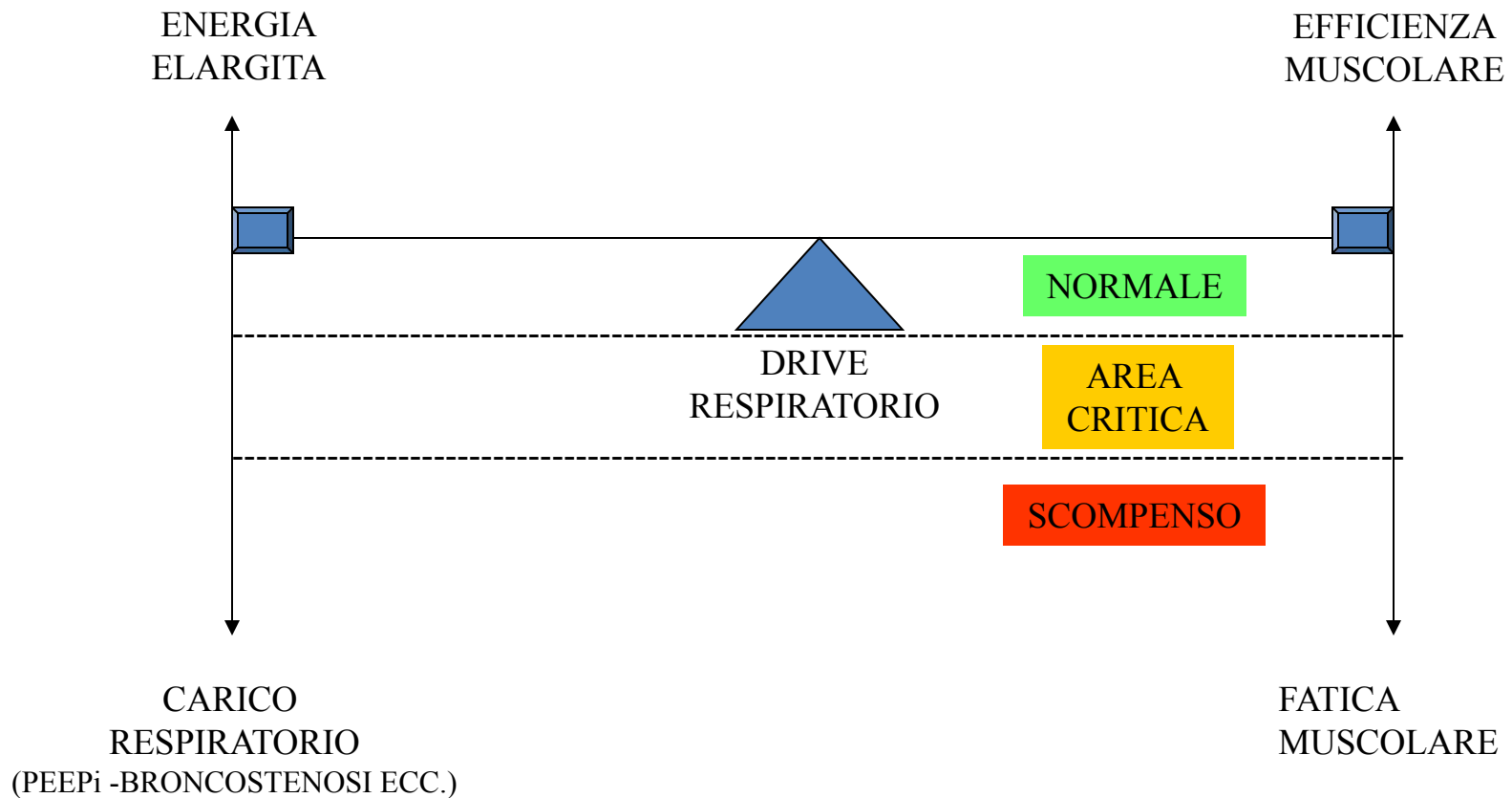


$FE < FI$ (Iperinsufflazione)

Resistive and PEEPi WOB

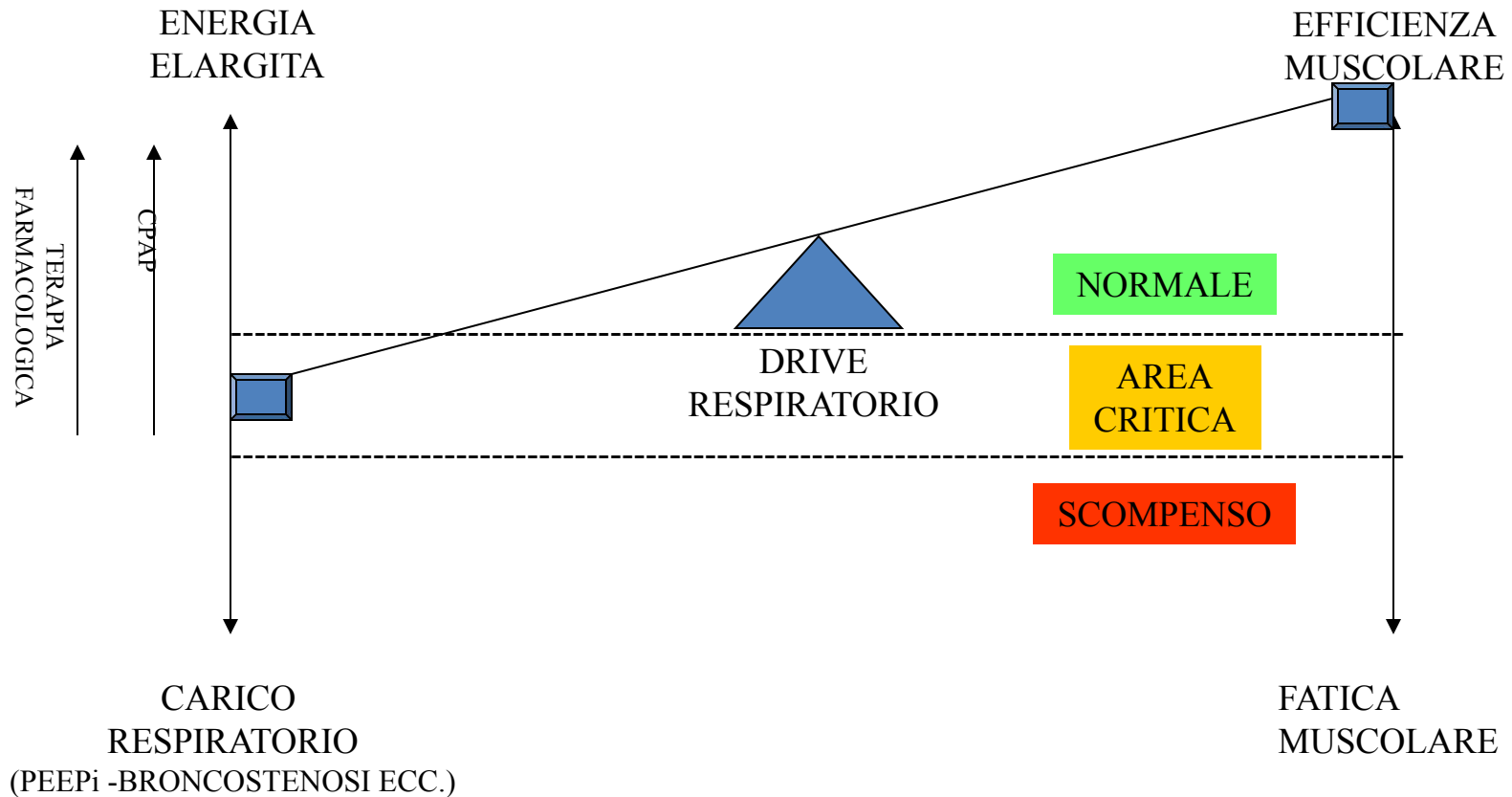


INSUFFICIENZA DI POMPA TORACICA



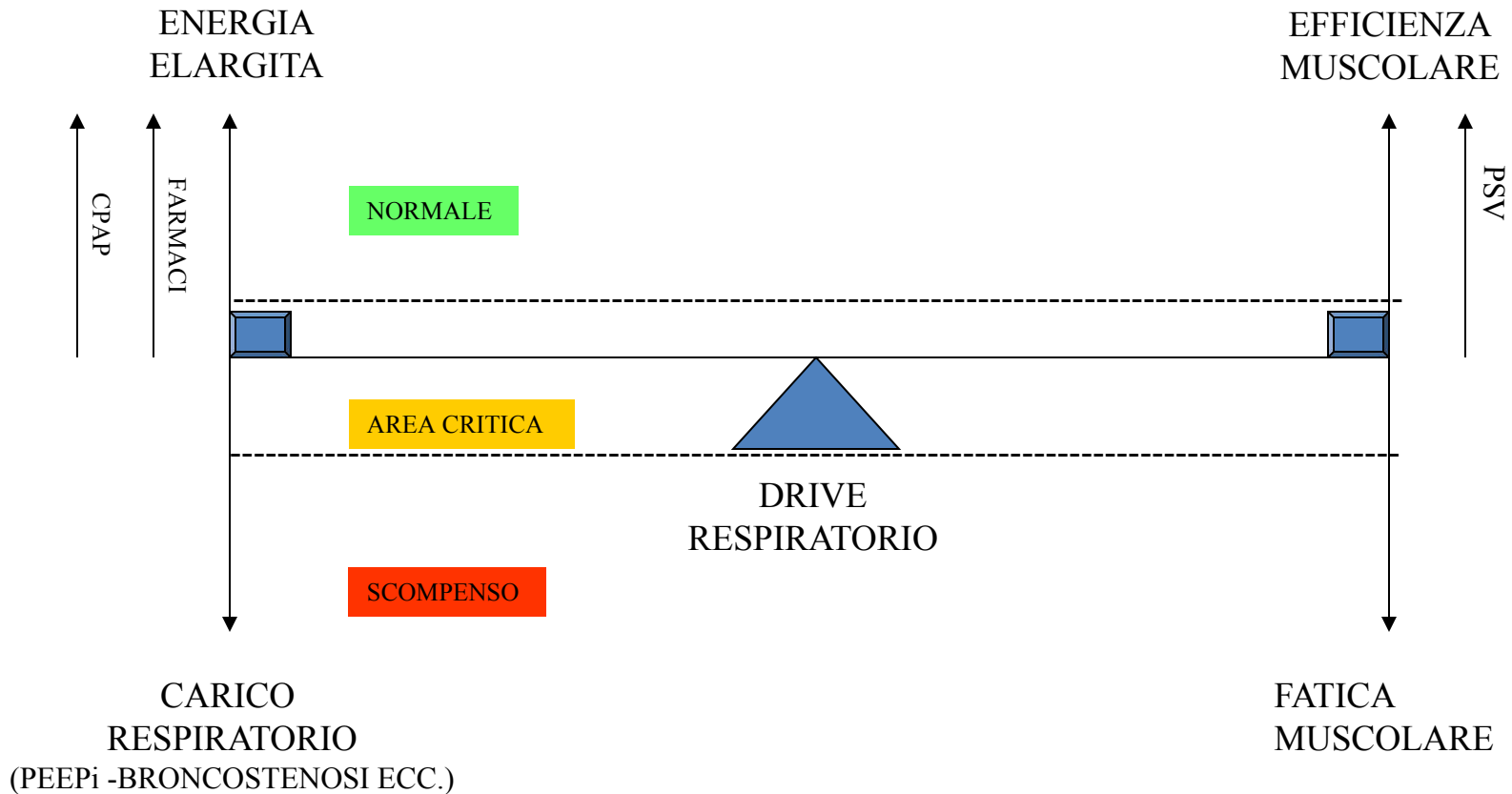
SOGGETTO NORMALE

INSUFFICIENZA DI POMPA TORACICA



AUMENTO DEL CARICO CON
EFFICIENTE RISPOSTA MUSCOLARE
(TERAPIA FARMACOLOGICA O CPAP A BASSA FiO2 E BASSA PEEP_e)

INSUFFICIENZA DI POMPA TORACICA



INEFFICIENTE RISPOSTA MUSCOLARE (FATICA)
CON SPOSTAMENTO GLOBALE DELL'ASSETTO
MECCANICO NELL'AREA CRITICA (BiPAP)

Bi PAP

SISTEMA DI VENTILAZIONE MECCANICA NON INVASIVA, IN MODALITA' PRESSOMETRICA, A DUE LIVELLI DI PRESSIONE POSITIVA:

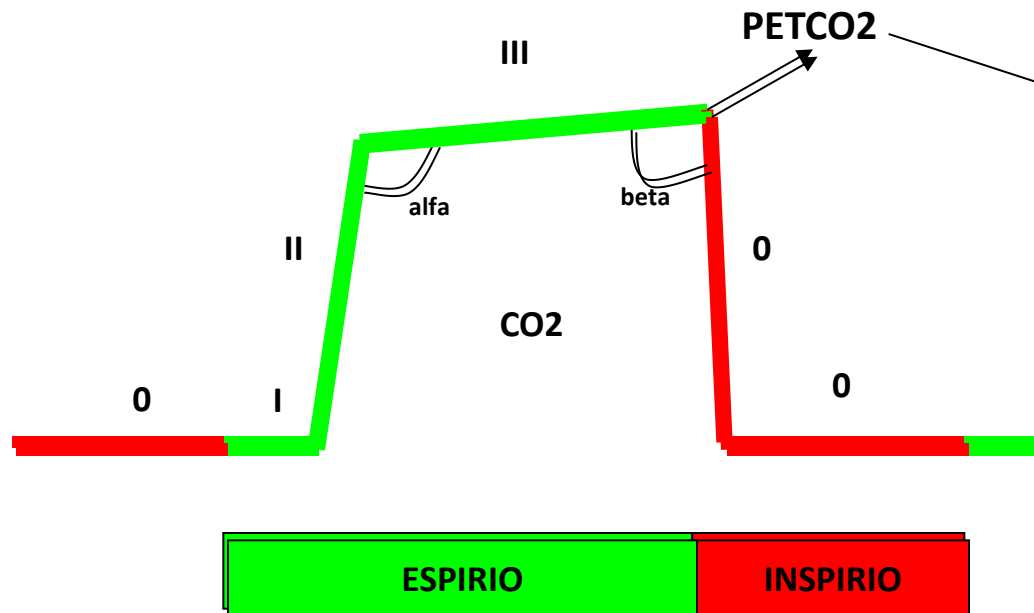
- IPAP (INSPIRATORIA) MAGGIORE (10-25 CM H₂O)**
- EPAP (ESPIRATORIA) MINORE (4-8 CM H₂O)**

CICLATO DAL PAZIENTE (MODALITA' IN RESPIRO SPONTANEO), MA AUTOMATICO SOTTO UNA SOGLIA STABILITA DI BRADIPNEA (MODALITA' ASSISTITA – CONTROLLATA)



Il Monitoraggio Capnometrico/Capnografico

La misurazione della CO₂ nell'aria espirata indica in maniera diretta le condizioni di eliminazione di CO₂ Dai polmoni. Indirettamente essa indica anche le caratteristiche della produzione tissutale di CO₂, del Trasporto di CO₂ dalla periferia ai polmoni attraverso il torrente circolatorio. Quindi la capnografia È un'importante tecnica non invasiva che permette di monitorare la produzione di CO₂, la perfusione E la ventilazione polmonare, nonché le principali turbe dell'equilibrio acido-base.



CAPNOGRAFIA



CAPNOMETRIA

Uso Classico nel Paziente Intubato

- Conferma Posizionamento Tubo Endotracheale
- Monitoraggio Respiratorio Nel Paziente Intubato sottoposto ad Sedazione Procedurale

Policy Statements

Expired Carbon Dioxide Monitoring

Board of Directors, September 1994

Board of Directors, June 1994

Sexual and Domestic Violence

Board of Directors, September 1994

American College of Emergency Physicians.

Expired Carbon Dioxide Monitoring

[American College of Emergency Physicians: Expired carbon dioxide monitoring. *Ann Emerg Med* March 1995;25:441.]

The American College of Emergency Physicians believes that quality emergency care should be available to all who seek it. ACEP endorses the following principles regarding expired carbon dioxide monitoring:

- The established method for verifying proper endotracheal tube placement is by direct visualization of the endotracheal tube through the vocal cords into the trachea.
- Carbon dioxide monitoring of tracheal intubation placement is desirable, but should not be mandated at this time for all emergency patients.
- It is desirable to have carbon dioxide monitoring devices available to emergency physicians and prehospital providers to assist in confirming tracheal intubation. Absence of these monitoring devices to confirm tracheal intubation should not delay or preclude intubation in life-threatening emergencies.
- Endotracheal tube placement should be confirmed whenever carbon dioxide monitoring indicates possible esophageal intubation, and reconfirmed if there is a change in the patient's clinical status, movement or transportation of patient, or suspected extubation.
- Carbon dioxide monitoring of expired gas in intubated patients can be performed qualitatively or quantitatively on a single, intermittent, or continuous basis with different monitoring systems.
- Carbon dioxide levels may be falsely low despite correct tracheal placement of the endotracheal tube in cardiac arrests, severe shock, and other clinical conditions with low cardiac outputs and inadequate tissue perfusion.
- Other uses of carbon dioxide monitoring are under investigation. Research is continuing to define the benefits and most appropriate uses of this technology.

This policy was prepared by the Clinical Policies Committee/EMS Committee and replaces one with the same title.

End-Tidal CO₂ Detectors Stir Controversy

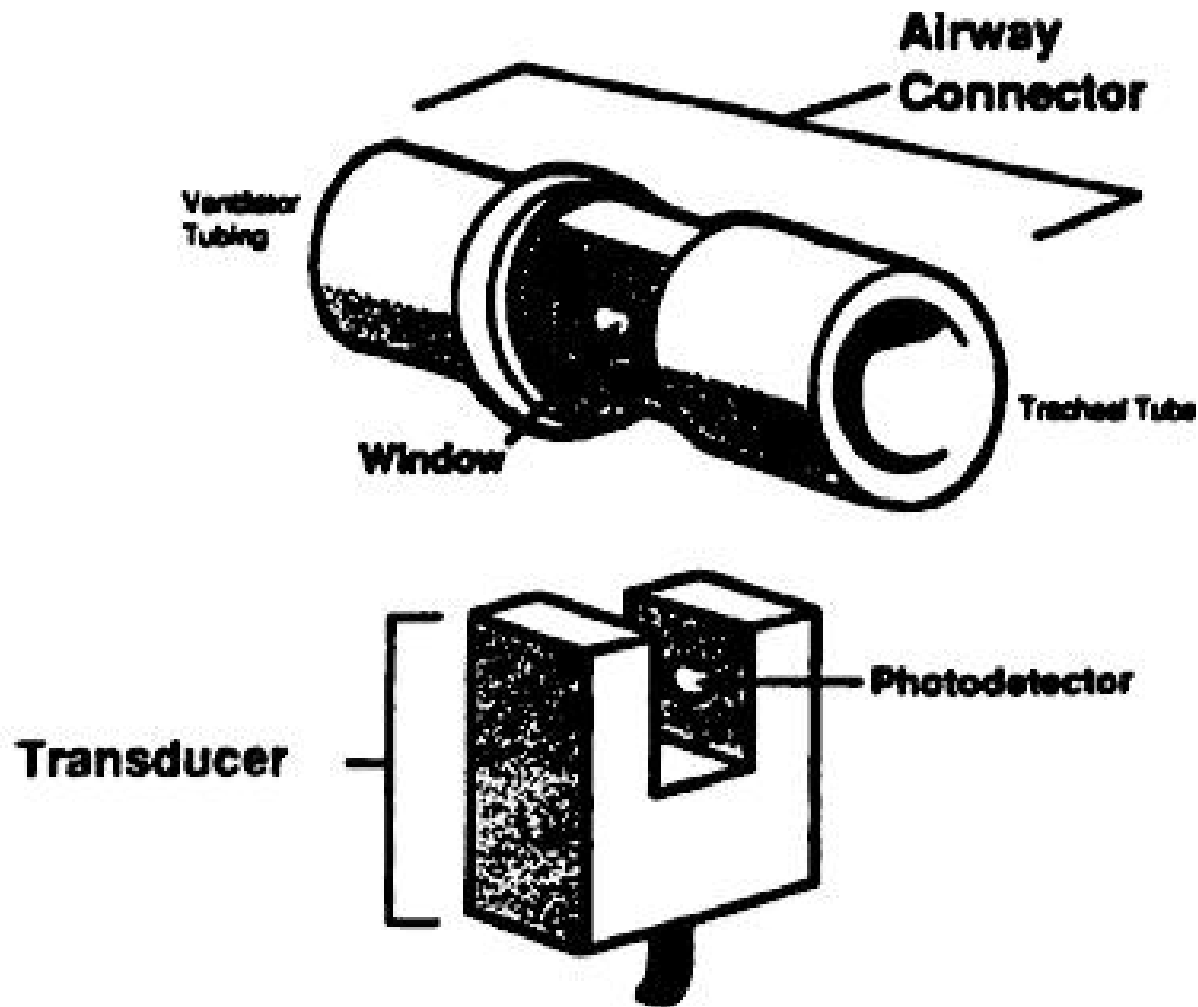
[Waeckerle JF: End-tidal CO₂ detectors stir controversy. *Ann Emerg Med* August 1994;24:320-321.]

One of the most important goals for *Annals* is to provide a forum for responsible and provocative debate. To that end, *Annals* recently published an article by William H Ginsburg, JD, titled, "When Does a Guideline Become a Standard? The American Society of Anesthesiologists Guidelines Give Us a Clue" [*Ann Emerg Med* December 1993;22:1891-1896]. This article provides us with an opportunity to discuss the development of practice standards, an issue of critical importance to emergency physicians. The article also provides a platform for thoughtful debate about the use, particularly in prehospital care, of end-tidal CO₂ detectors, a device that is being utilized but has not been completely studied.

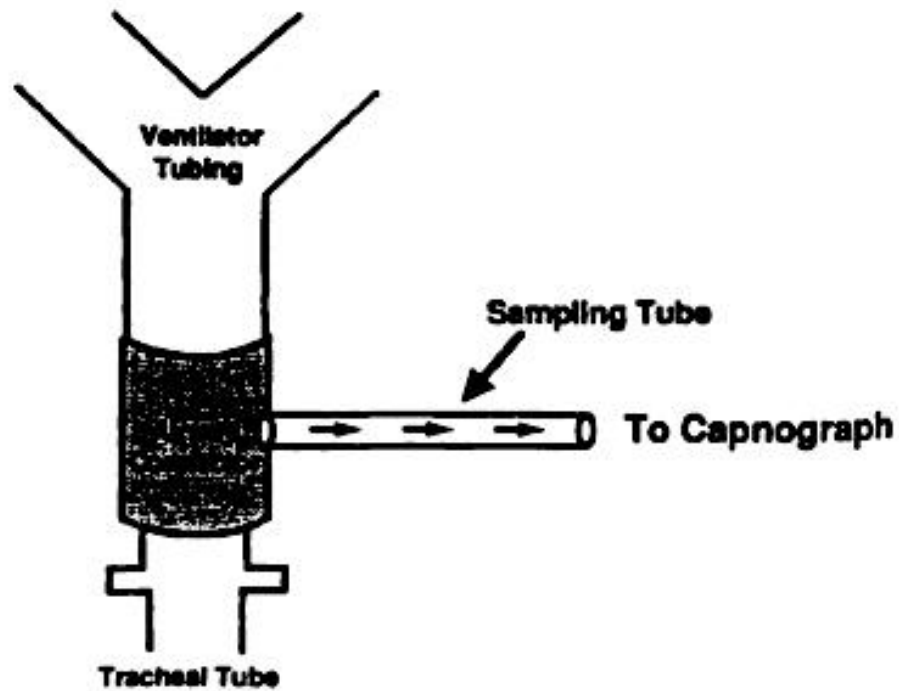
Prehospital care is one of emergency medicine's foremost responsibilities. As devices are introduced for use in prehospital care, we must ensure that they undergo vigorous scientific scrutiny to validate their use. Devices already in use must also continually be reassessed by experts in the field to ensure that they benefit patients. End-tidal CO₂ detectors have not been rigorously studied nor have they been in use long enough for those of us in the prehospital arena to be certain they are beneficial and cost-effective.

When considering this article for publication, I was reminded of a similar scenario with the pneumatic antishock garment. In the early 1970s, the pneumatic antishock garment was promoted extensively; however, the device had not undergone strict scientific evaluation before marketing. Once available, this device received acceptance and was used extensively in the field even though the precise mechanism of action, indications, and contraindications were not clearly identified for some time. In an attempt to ensure that history not repeat itself, *Annals* published the article by Ginsburg to stimulate our readers to consider not only the use of end-tidal CO₂ detectors but also the pro-

Tecnica Main Stream



Tecnica Side Stream

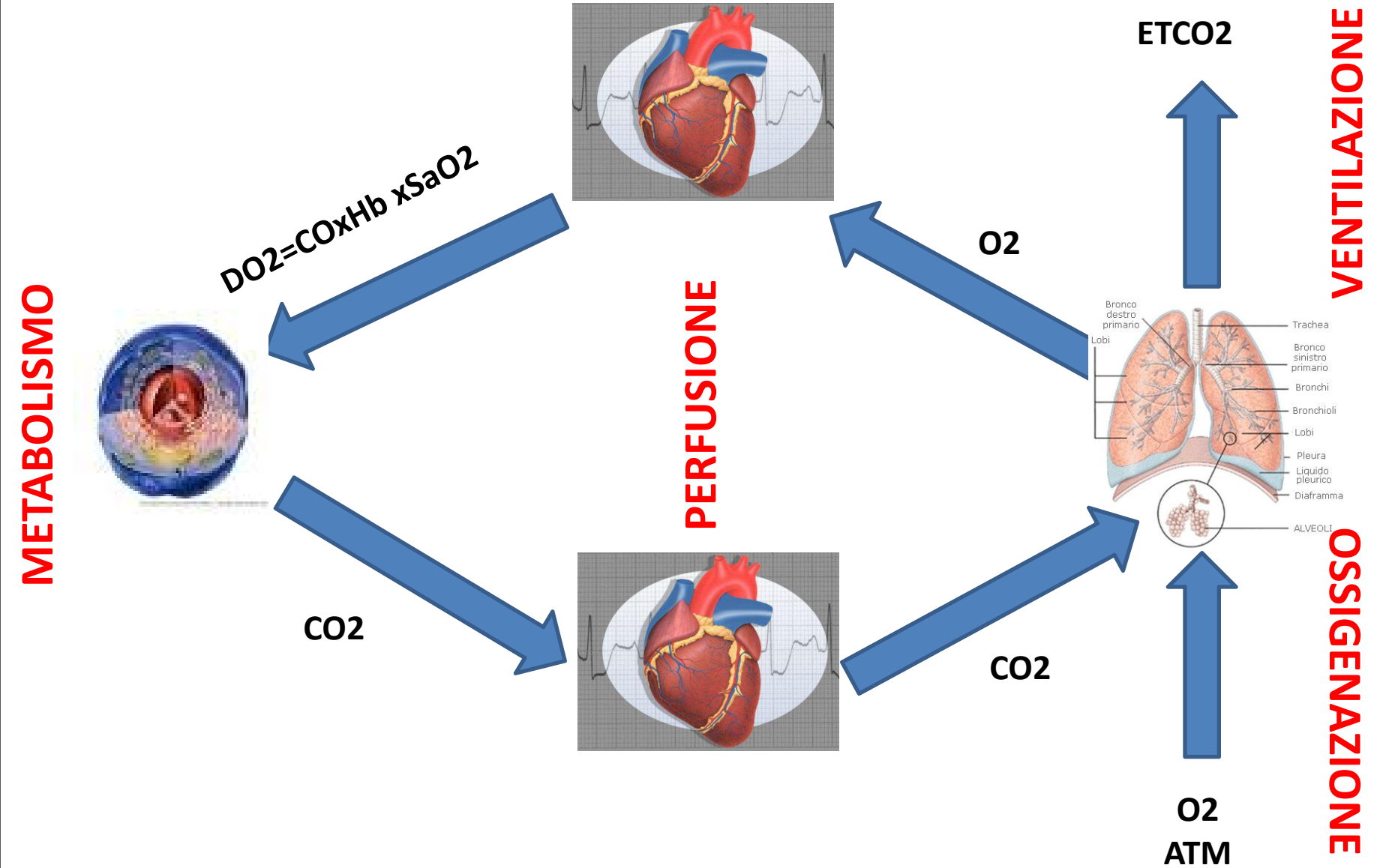


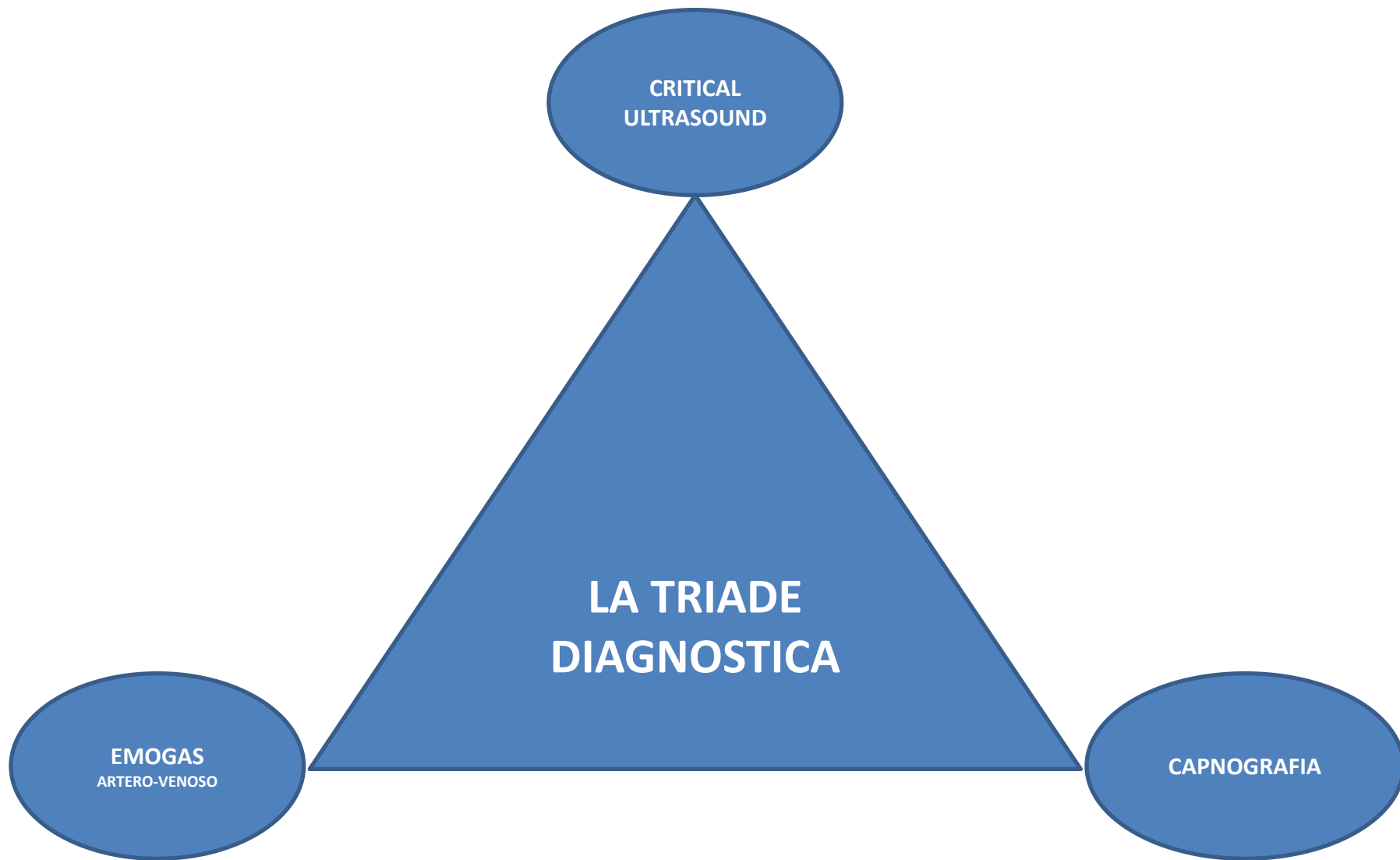
Possibilità di monitoraggio nel paziente non intubato

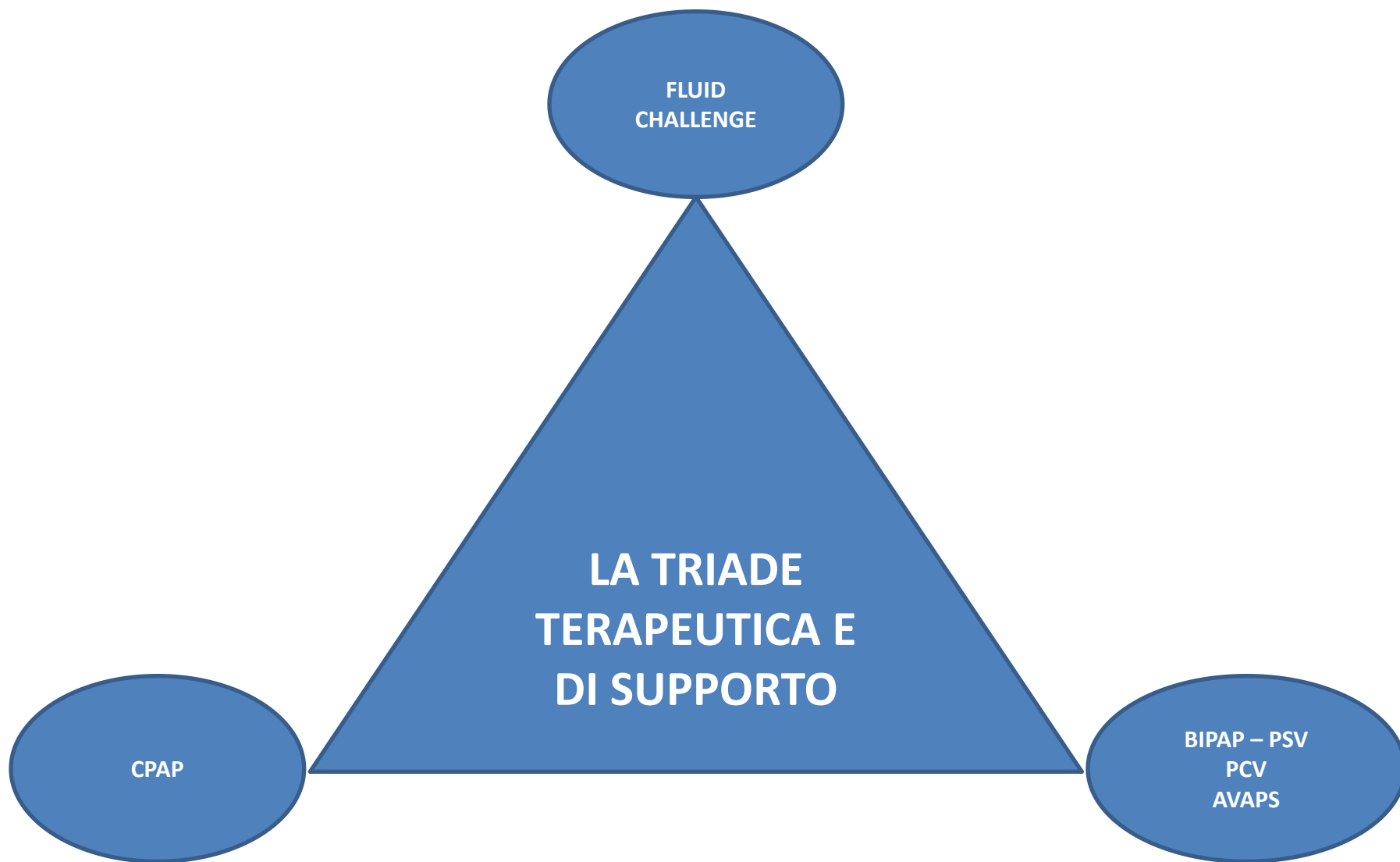




LE VARIABILI FISIOPATOLOGICHE NEL PAZIENTE CRITICO







METABOLISMO
Sindrome Ipercinetica

OSSIGENAZIONE
Eco Polmonare
Funzione Ventricolare sx
Ventricolo Dx

**CRITICAL
ULTRASOUND**

PERFUSIONE
Funzione Ventricolo sx
PVC da Vena Cava Inferiore

MACRO

VENTILAZIONE
Cinetica Diaframmatica
Eco Pleura
Ventricolo Dx

METABOLISMO
Acidosi Metabolica

OSSIGENAZIONE
PaO₂/FiO₂

EGA

PERFUSIONE
LATTATO
SaO₂-ScvO₂
Delta v-a CO₂

VENTILAZIONE
PCO₂
Acidosi Respiratoria

METABOLISMO

Acidosi Metabolica

PETCO2 RIDOTTA

Pa-ETCO2 normale

OSSIGENAZIONE

PaO2/FiO2

PETCO2

PERFUSIONE

SaO2-ScvO2

PETCO2 RIDOTTA

Pa-ETCO2 Aumentata

VENTILAZIONE

PCO2

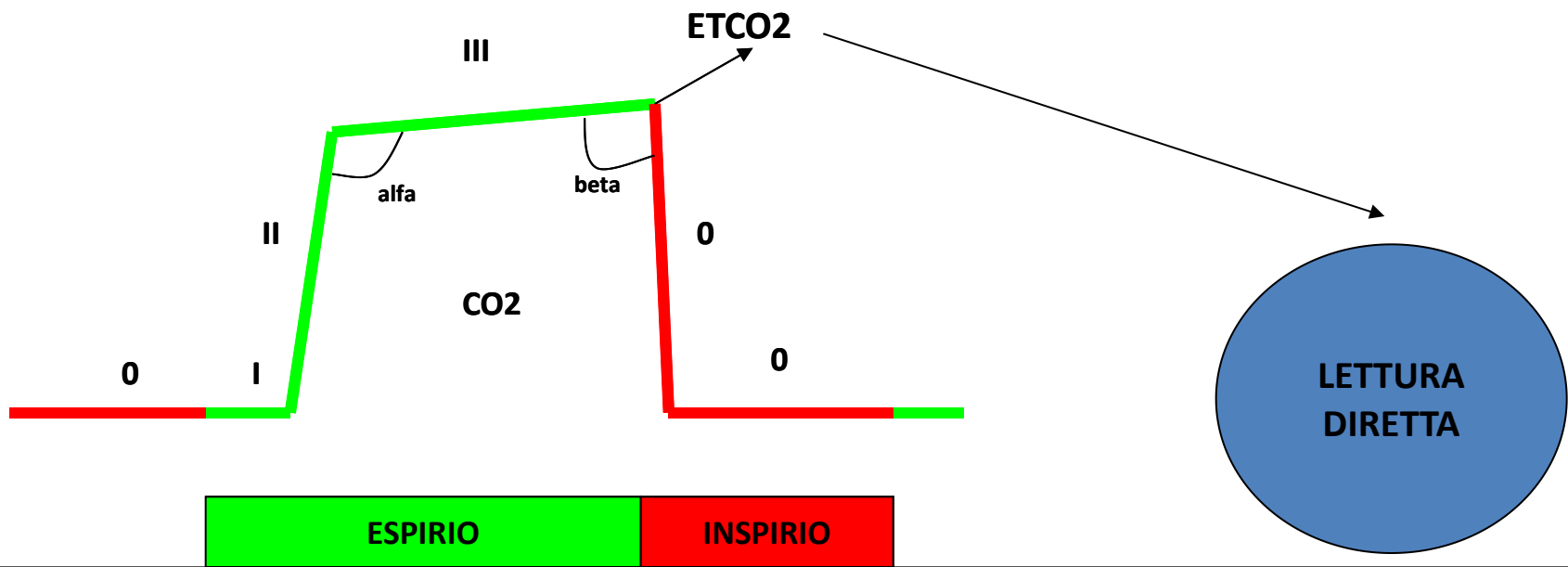
Acidosi Respiratoria

PETCO2 AUMENTATA

Pa-ETCO2 Aumentata (PEEPI)

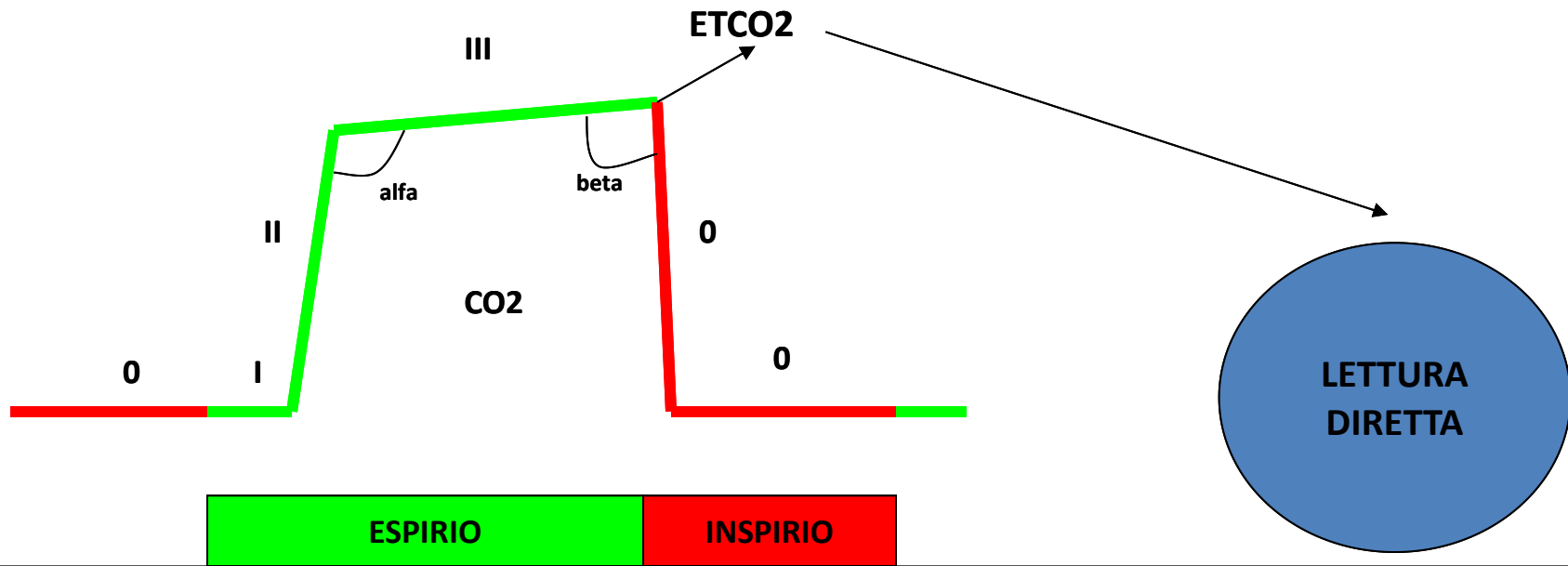
Le Fasi del Capnogramma

- Fase 0 = inspirio
- Fase I = Spazio Morto Anatomico
- Fase II = Mix Spazio Morto Anatomico - Aria Alveolare (spazio morto alveolare)
- Fase III = Plateau alveolare



I Parametri Da Considerare

- Ritmo e Frequenza dei Capnogrammi
- Altezza del Capnogramma
- Pendenza della fase II (ampiezza dell'angolo alfa)
- PETCO₂ (Pressione Parziale di CO₂ alla fine dell'espirio)
- PaCO₂ – PETCO₂ (a-PETCO₂)
- Pendenza della fase 0 (angolo beta)



RITMO E FREQUENZA

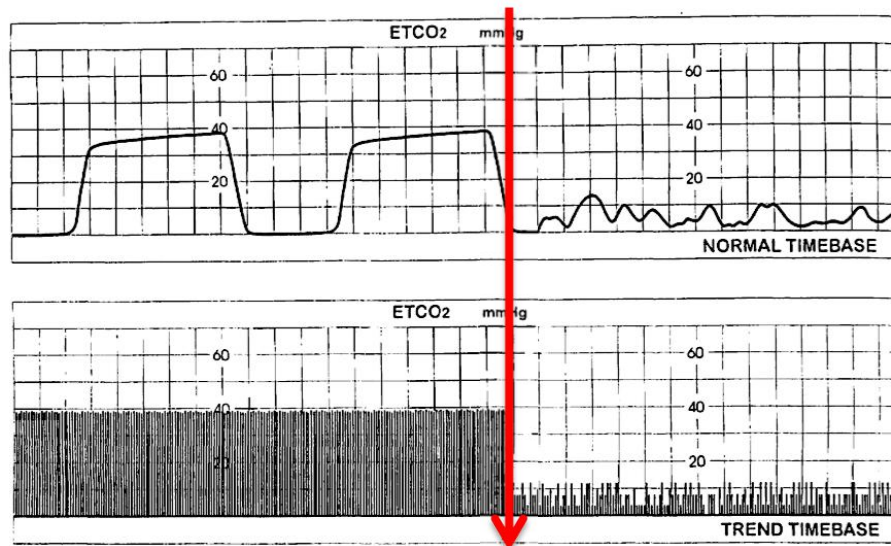
**IL metodo capnografico è il metodo più affidabile per l'analisi del ritmo
E della frequenza respiratoria perché basata sull'analisi della CO2 espirata
E quindi sugli atti ventilatori efficaci**

GENERAL MEDICINE/ORIGINAL RESEARCH

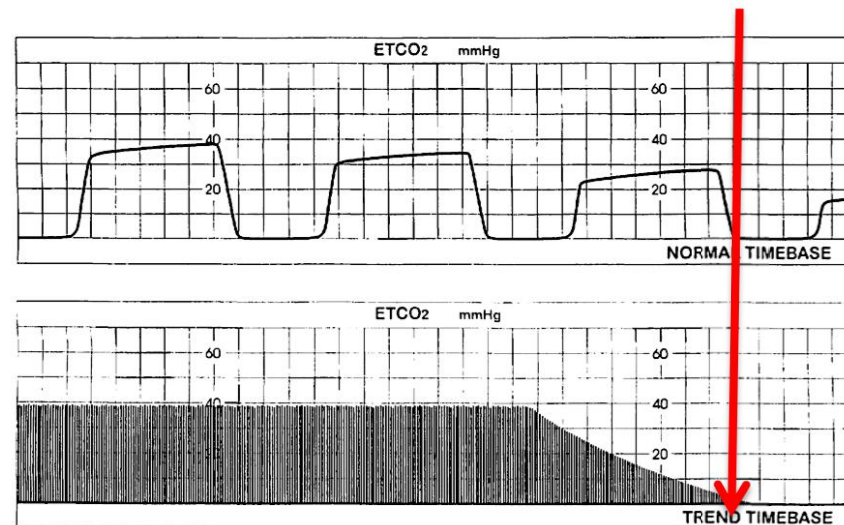
The Vexatious Vital: Neither Clinical Measurements by Nurses Nor an Electronic Monitor Provides Accurate Measurements of Respiratory Rate in Triage

Paris B. Lovett, MD
Jason M. Buchwald, MD
Kai Stürmann, MD
Polly Bijur, PhD

From the Columbia University Medical Center, New York, NY (Lovett); Memorial West Hospital, Pembroke Pines, FL (Buchwald); Beth Israel Medical Center, New York, NY (Stürmann); and the Albert Einstein College of Medicine, New York, NY (Bijur).



**ARRESTO CARDIACO E/O RESPIRATORIO
IMPROVISO**

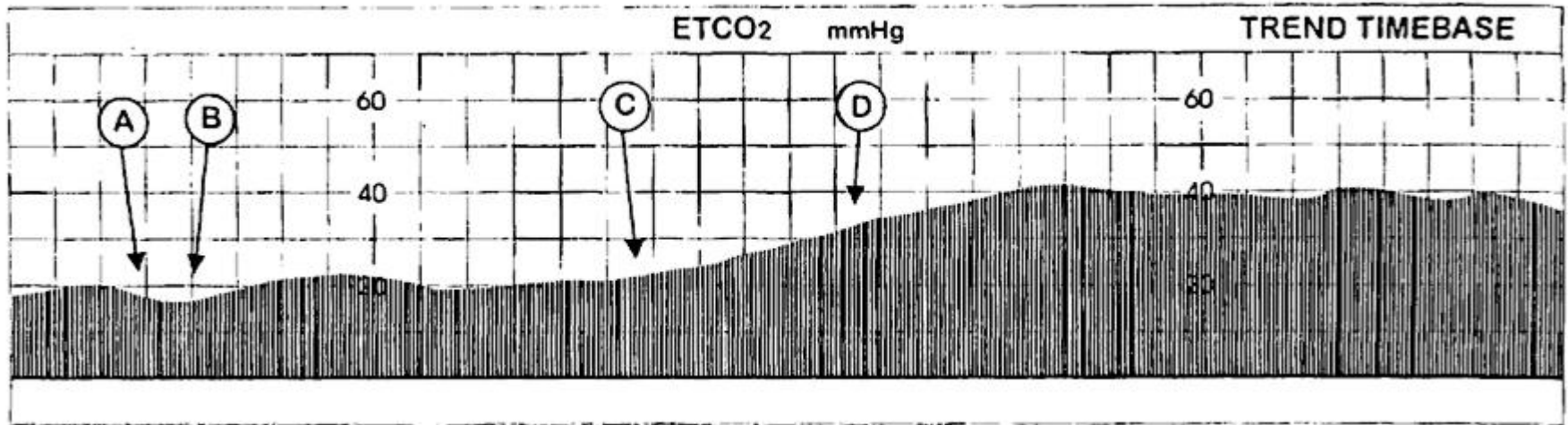


**ARRESTO CARDIACO E/O RESPIRATORIO PRECEDUTO DA UNA FASE DI
PREARRESTO**

END-TIDAL CARBON DIOXIDE AND OUTCOME OF OUT-OF-HOSPITAL CARDIAC ARREST

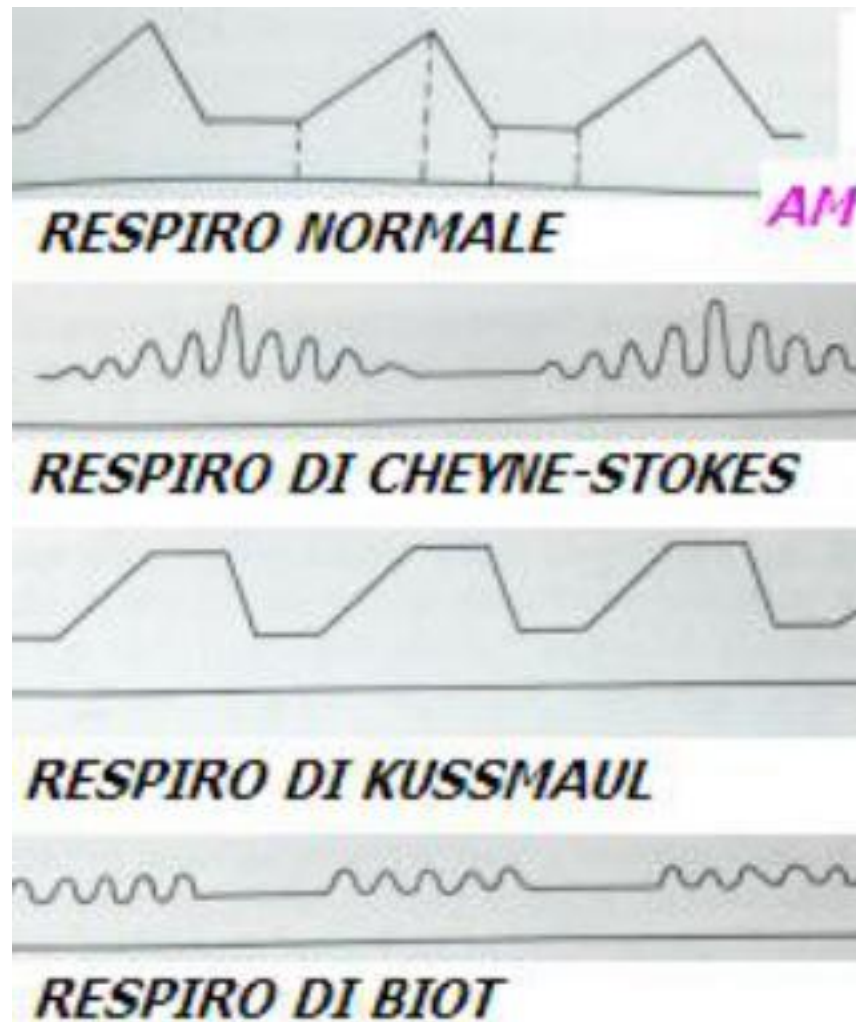
ROBERT L. LEVINE, M.D., MARVIN A. WAYNE, M.D., AND CHARLES C. MILLER, PH.D.

Nejm 1997

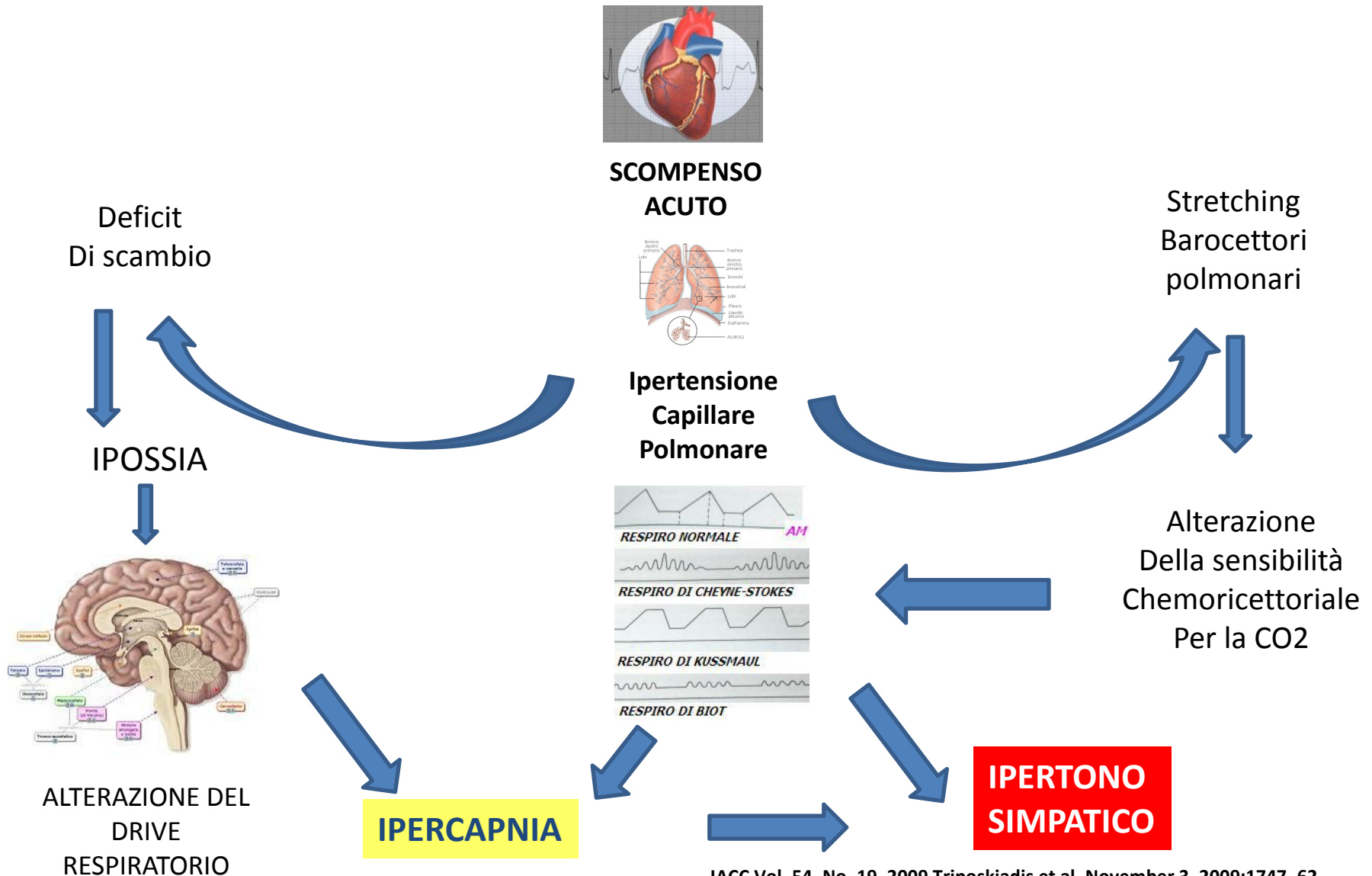


pseudoPEA

Alterazioni del Ritmo e del Sincronismo Ventilatorio nello Scompenso Cardiaco Acuto

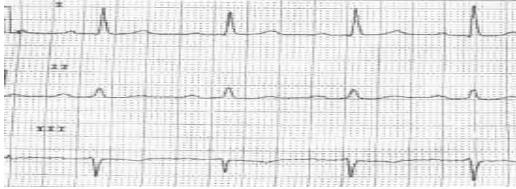


ALTERAZIONI DELLA MECCANICA POLMONARE IN CORSO DI SCOMPENSO CARDIACO ACUTO



POSSIBILITA' DI SUPPORTO IMMEDIATO!

Le Variabili del Monitoraggio Subintensivo



TRACCIA ECG

ATTIVITA' ELETTRICA



TRACCIA PLETISMOGRAFICA

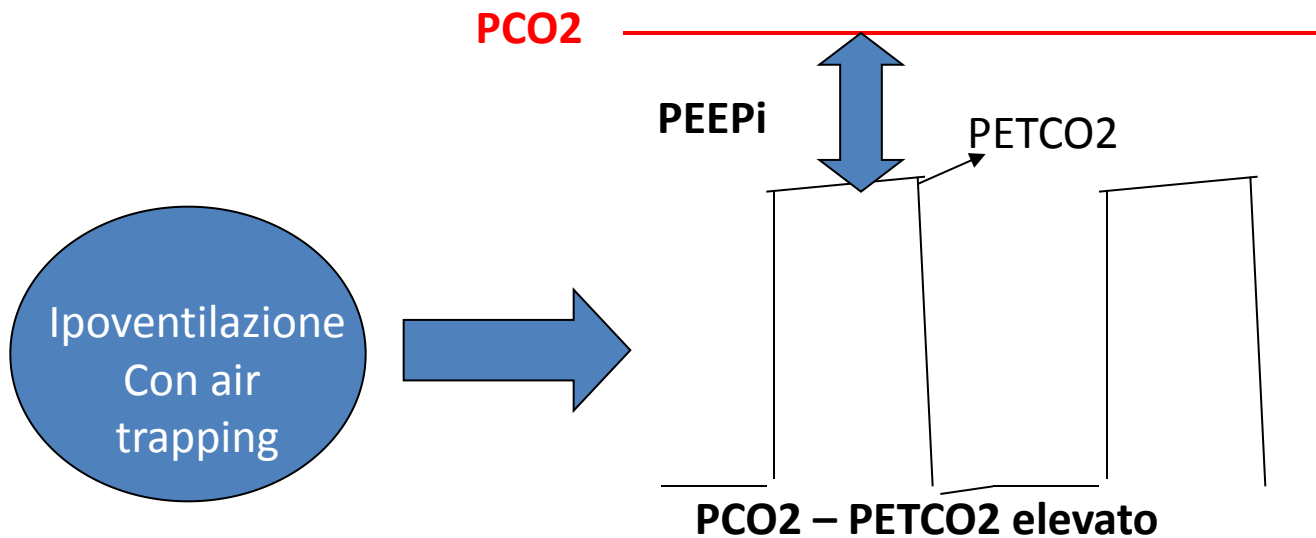
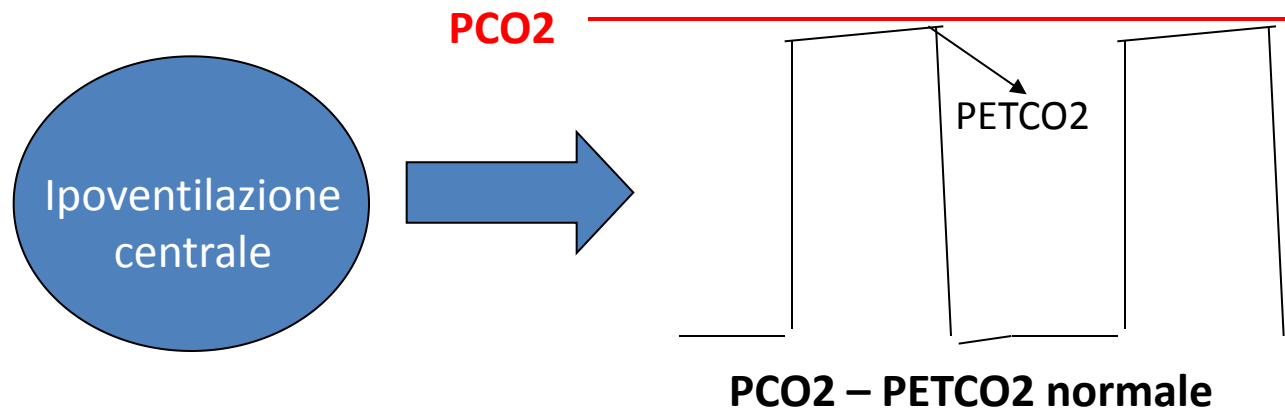
SISTOLE MECCANICA E VOLEMIA



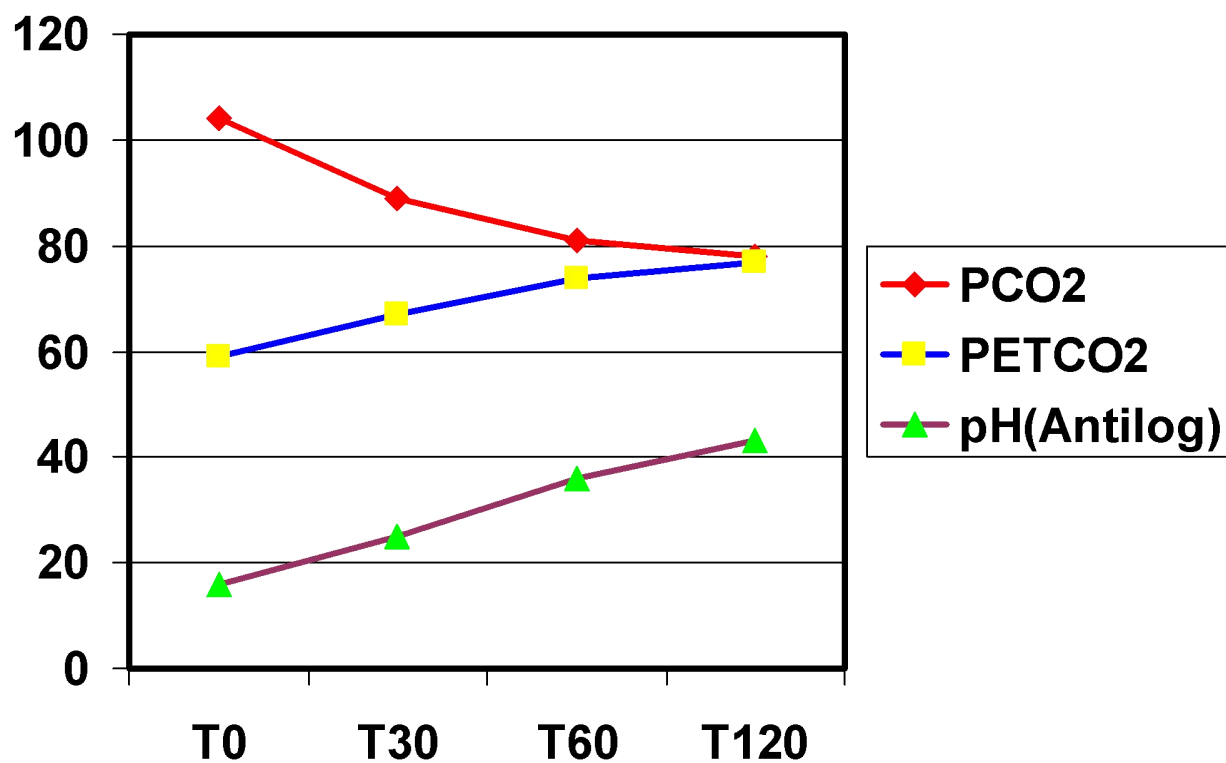
CAPNOGRAFIA

EFFICACIA PERFUSIONE E VENTILAZIONE

LA CAPNOGRAFIA NELL'IPOVENTILAZIONE E IPERCAPNIA



Effetti dell'applicazione della PSV sul Tracciato capnografico nell'IRA ipercapnica



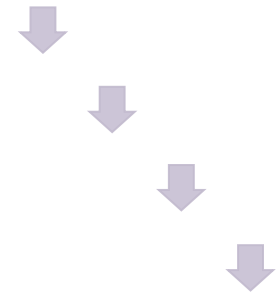
Open Access Emergency Medicine June 2013

End-tidal arterial CO₂ partial pressure gradient in patients with severe hypercapnia undergoing Non invasive ventilation

V. De Filippis MD, D. D'Antini MD, G. Cinnella MD, M. Dambrosio MD, F. Schiraldi MD, V. Procacci MD

Misurazioni

Emogasanalisi
End-tidal
CO₂
(capnografi
a side-
stream)



Trattamento farmacologico e fluidoterapia secondo linee guida



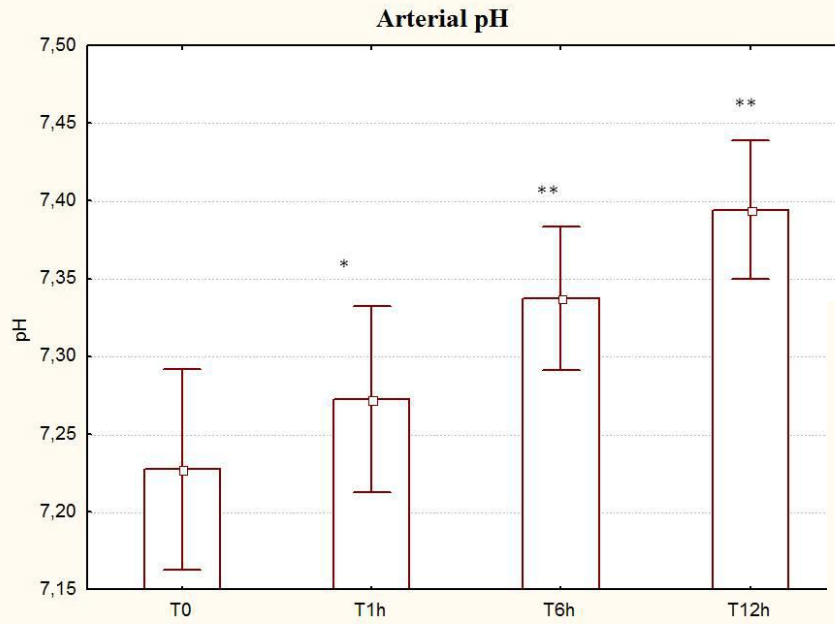
RISULTATI

BPCOr
(60%)

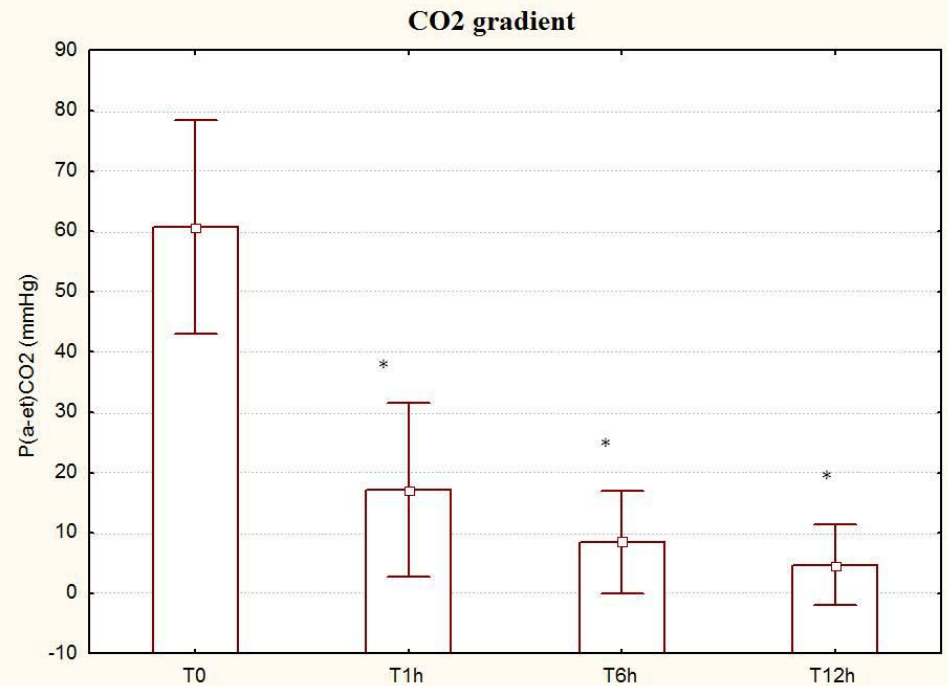
CAUSE

Polmonite
(10%)

EPA (30%)



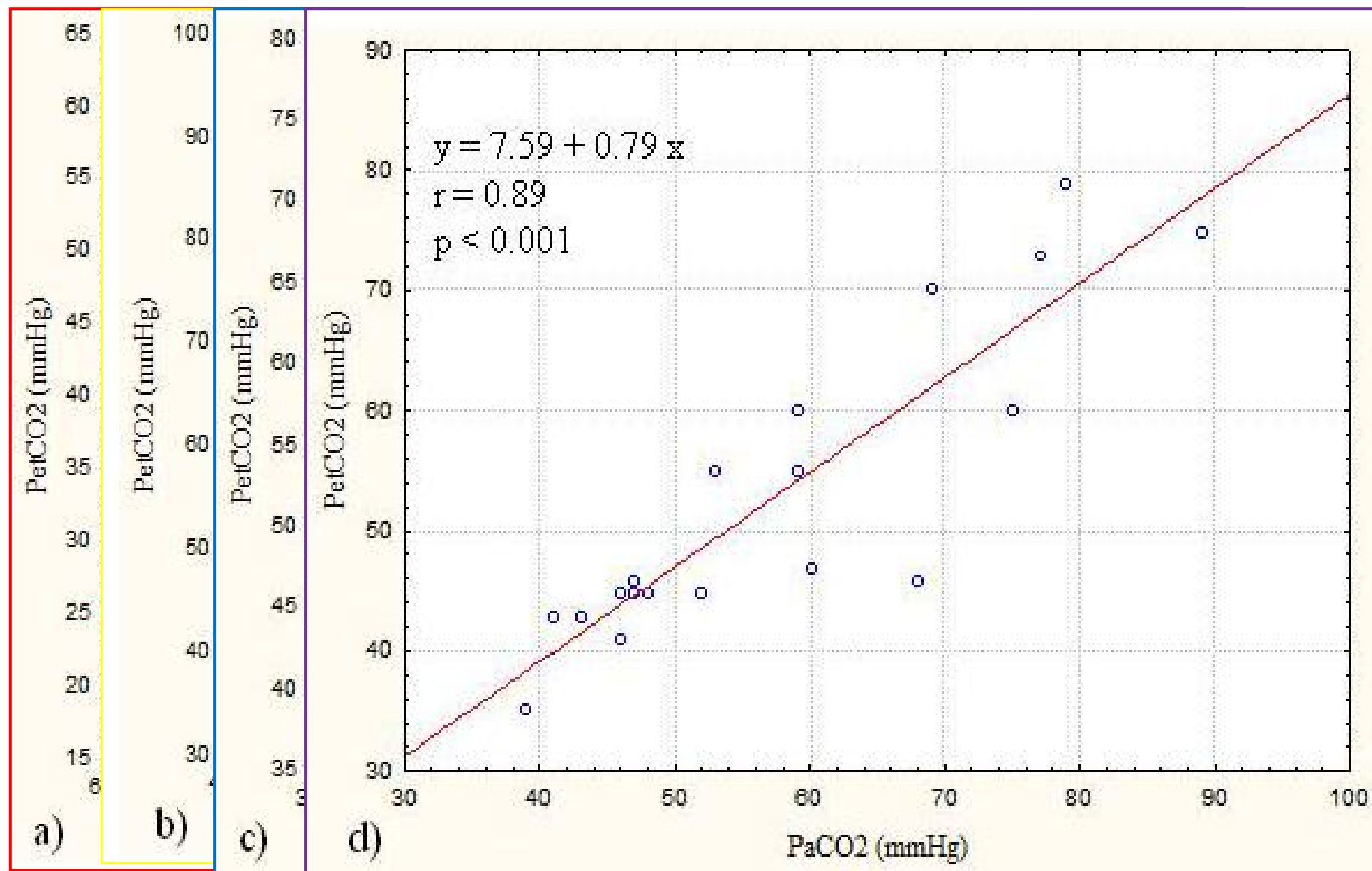
* $p < 0.05$
 ** $p < 0.001$



* $p < 0.001$

RISULTATI

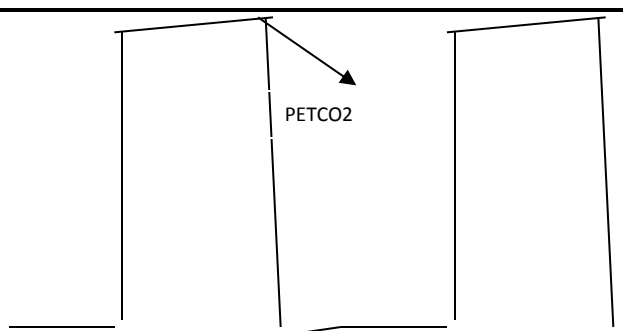
CORRELAZIONE TRA CO₂ ARTERIOSA STIMATA (EtCO₂) E MISURATA (PaCO₂)



Interazioni Capnografia – Critical Ultrasound

CAPNOGRAFIA

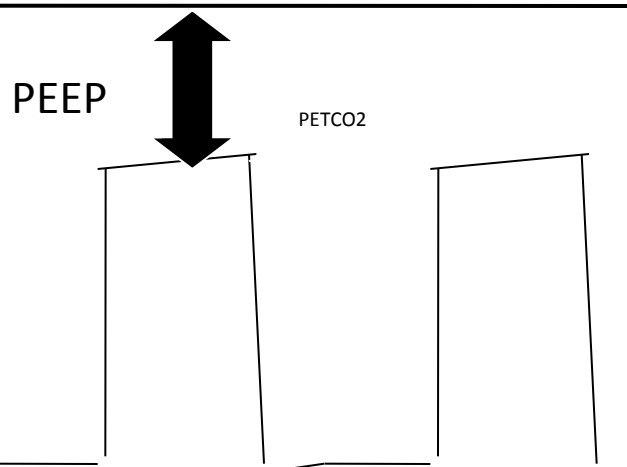
PCO₂



PCO₂ - PETCO₂ normale

IPOVENTILAZIONE CENTRALE

PCO₂



PCO₂ - PETCO₂ elevato

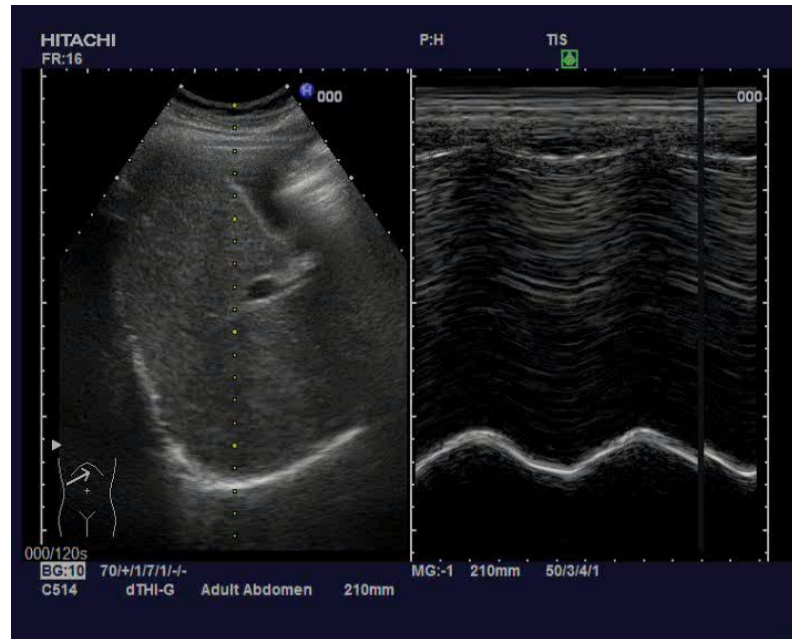
IPOVENTILAZIONE PERIFERICA

ECOGRAFIA

- RIDUZIONI ESCURSIONI DIAFRAMMATICHE

- POLMONE UMIDO O SECCO
- EV ADDENSAMENTI
- EV. VERSAMENTO PLEURICO
- VENTRICOLO DX DILATATO

LA CRITICAL ULTRASOUND NEL DEFICIT DI VENTILAZIONE



CINETICA DIAFRAMMATICA

Take Home Points

- **Il Monitoraggio Capnografico/Capnometrico consente una valutazione beat to beat, totalmente non invasiva, dei principali parametri fisiopatologici del paziente critico (ossigenazione, perfusione, ventilazione e metabolismo)**
- **Nell'Insufficienza Respiratoria Ipercapnica essa fornisce informazioni aggiuntive riguardanti la frequenza, il ritmo e il sincronismo ventilatorio, permettendo una titolazione della PEEP endogena tramite il differenziale PaCO₂-ETCO₂**
- **In associazione alla critical ultrasound e all'emogas artero-venoso assume un ruolo importante nel monitoraggio semintensivo del paziente trattato con NIMV**



Grazie !

Vito Procacci



XI congresso nazionale

simeu

ROMA 24-26 MAGGIO 2018

