



Congresso Palma di Maiorino Palacongressi 18-21 Ottobre 2012

Corso pregressuale
18 Ottobre 2012



Eco del diaframma e weaning

Lucia Morelli, Med d'Urgenza, Pronto Soccorso, OBI, Osp San Paolo Napoli

2 Gennaio 2012 ore 15.20

*Giovanni, 88 anni, viene
accompagnato in PS dal 118
per "stato soporoso" in BPCO*

*FR 35 min, apiretico
PA 140\80mmHG
Aritmico per fa
(FVM 110bpm),
MV ridotto a dx
ulcere flebostatiche*

Il suo EGA:
FIO₂ 0.24
FR 35
pH 7.28
pCO₂ **107**
PO₂ 86
Lat 0.6
HCO₃ **50.3**

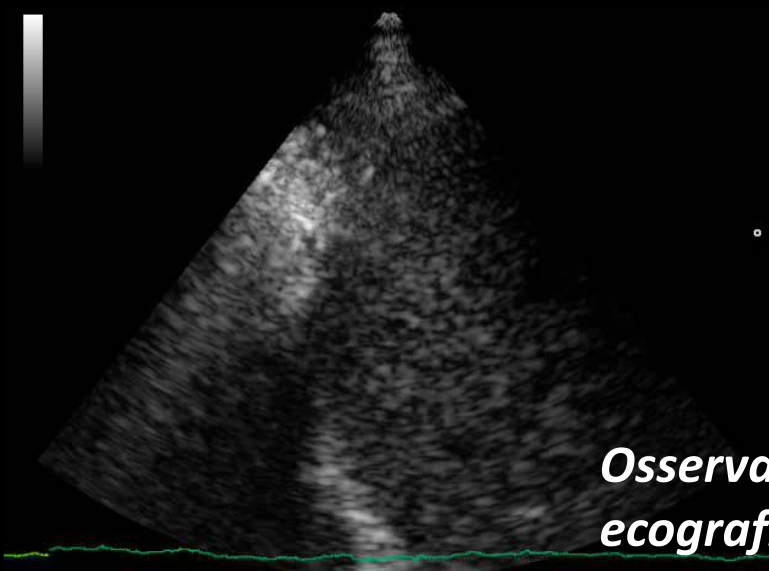


Si ricovera in
Medicina d'Urgenza
per effettuare **NIV**
(modalità APCV) con
IPAP 22 ed **EPAP 6**
O₂ 3 lit/min

B F P G 67%
TEI P 10 cm XV 1
PRC 7-3-B PRS M
PST 2

FACTORY PA230

FC <<

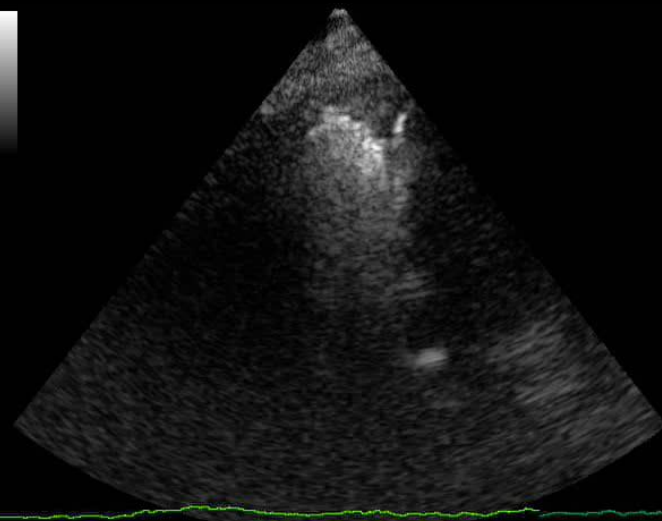


*Osservazione
ecografica bedside:
sliding pleurico*

B F P G 67%
TEI P 14 cm XV 1
PRC 7-3-B PRS M
PST 2

FACTORY PA230

FC <<



B F P G 82%
TEI P 25 cm XV 1
PRC 7-3-B PRS M
PST 2

FACTORY PA230

FC <<



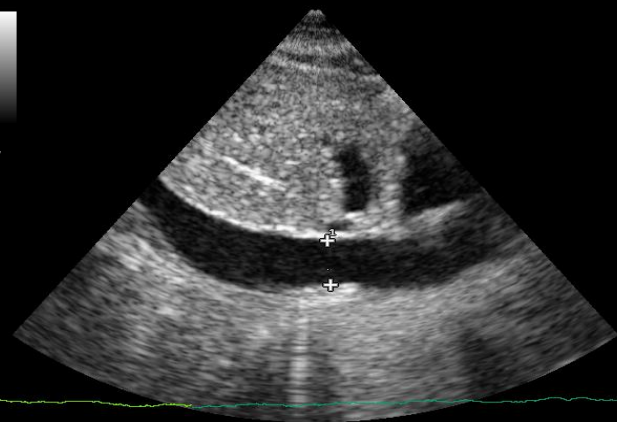
*presente,
In sede basale a dx
area di
consolidamento
alveolare con minima
falda versamento
pleurico consensuale.
VCI con indice di
collassabilità < 30%
VSX con FE 40%*

B F P G 67%
TEI P 14 cm XV 1
PRC 7-3-B PRS M
PST 2

FACTORY PA230

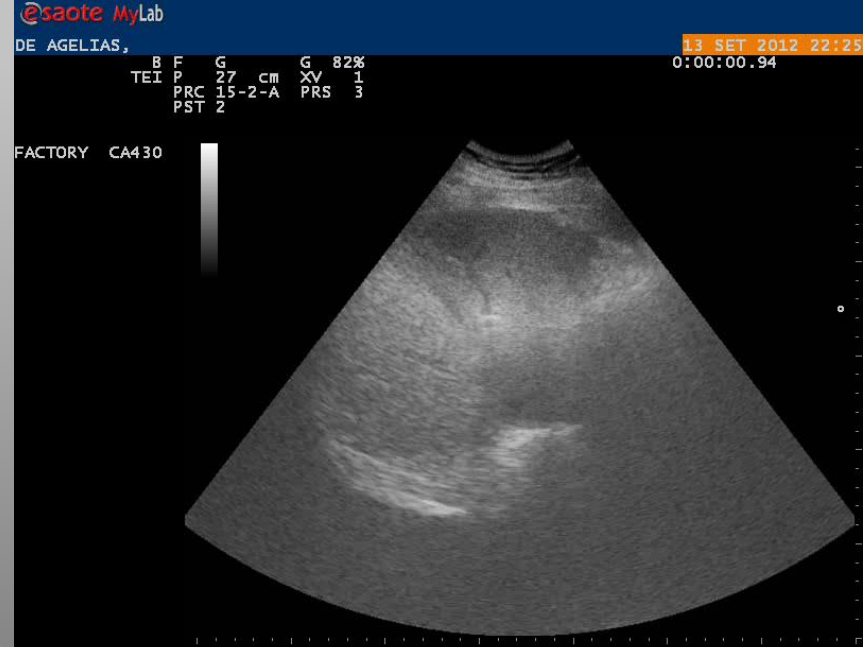
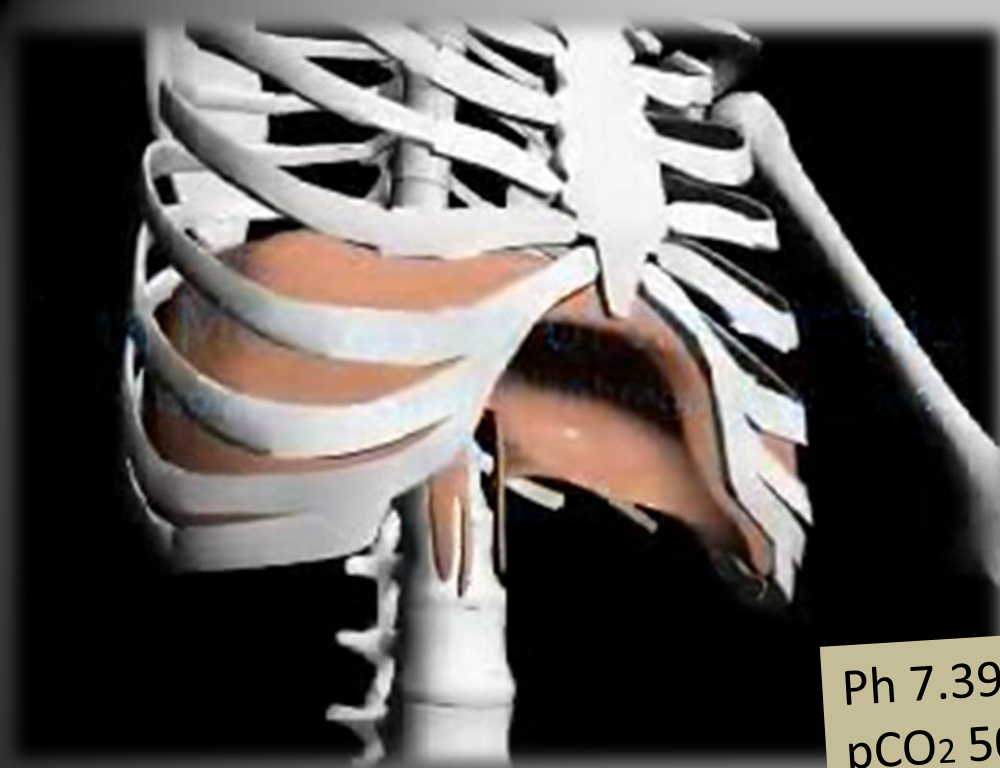
D1 15.0 mm

FC <<

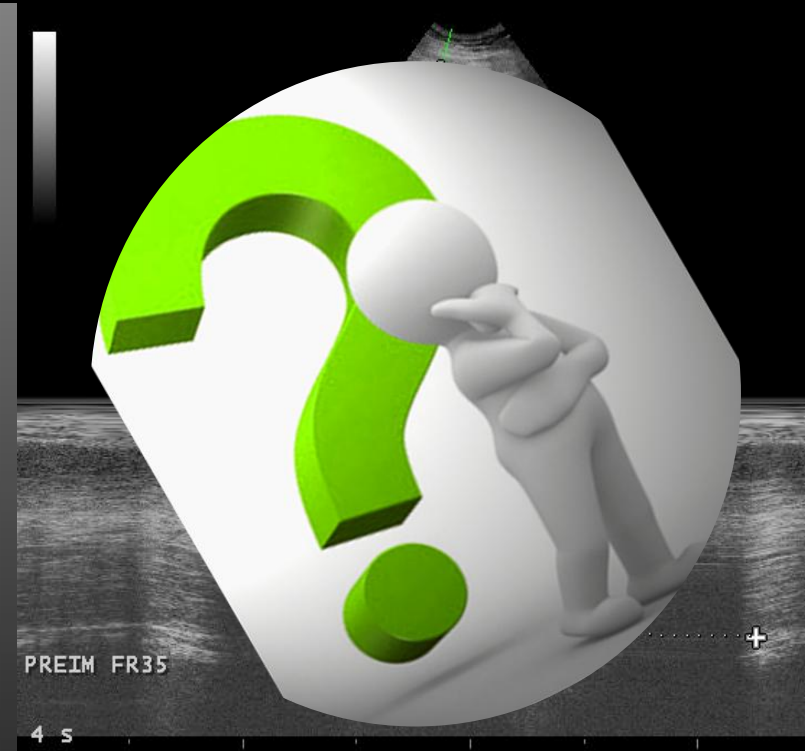


....e se avessimo altre informazioni?

...facciamo un passo indietro...



Ph 7.39
pCO₂ 50
pO₂ 53
Lat1.2
FR 32
FiO₂ 30



PREIM FR35

4 s

Original Research

Ultrasonography

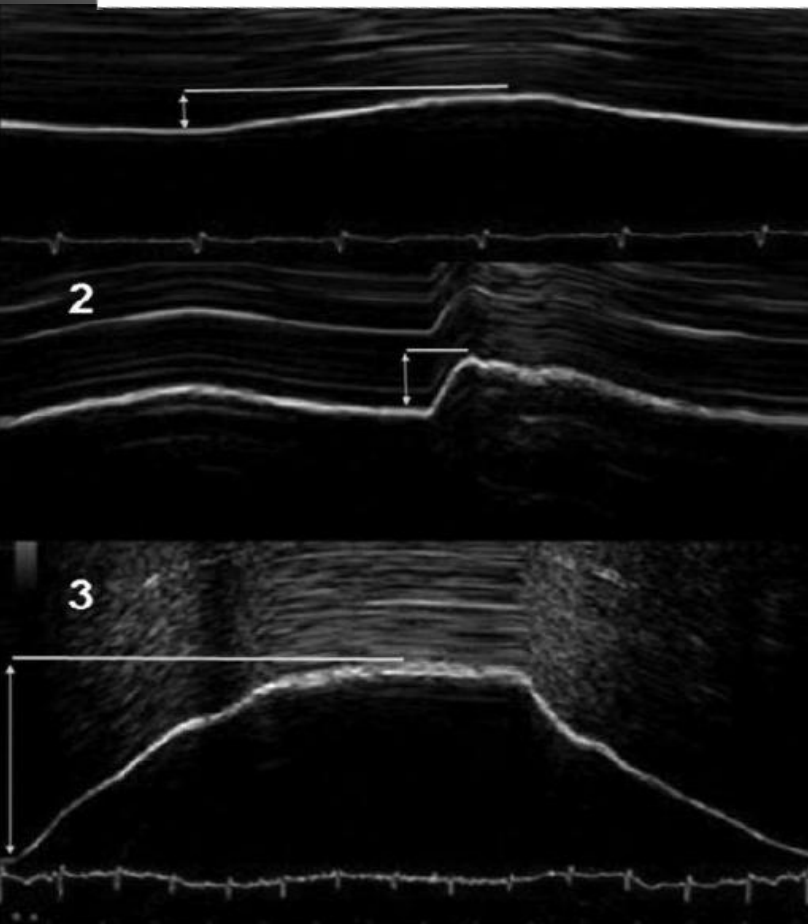
Diaphragmatic Motion Studied by M-Mode Ultrasonography

Methods, Reproducibility, and Normal Values

Alain Boussuges, MD, PhD 

Yoann Gole, MSc

Philippe Blanc, MD



-riposato: 1.5-2cm (limite 0.9 D-1 U)

-sniffing: 2.5-3cm (limite 1.6 D-1.8 U)

-profondo-forzato: 6-7 cm

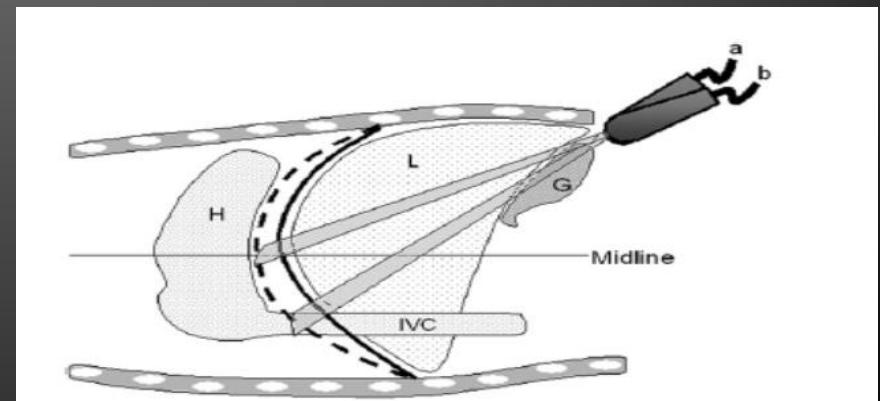
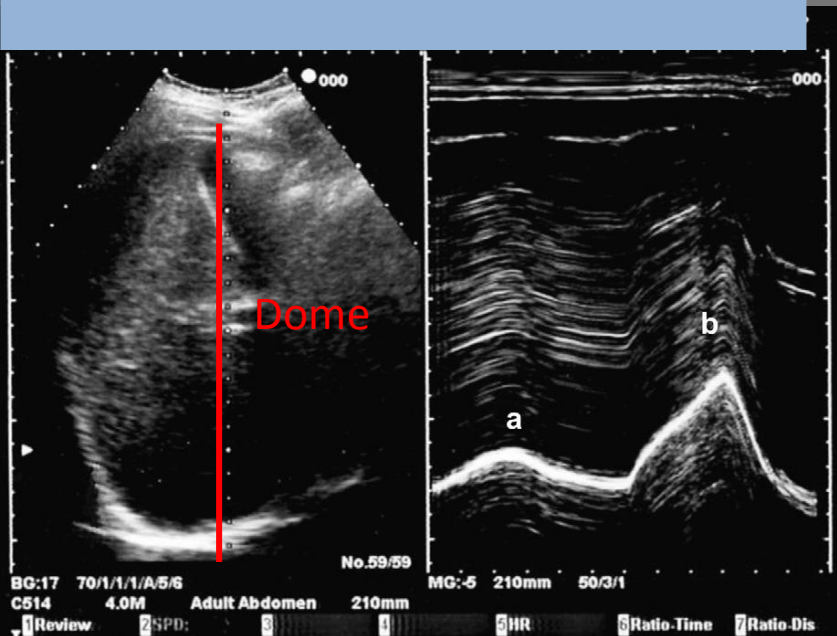
(limite 3.9D- 4.7U)

ULTRASOUND M-MODE ASSESSMENT OF DIAPHRAGMATIC KINETICS BY ANTERIOR TRANSVERSE SCANNING IN HEALTHY SUBJECTS

AMERICO TESTA,* GINO SOLDATI,[†] ROSANGELA GIANNUZZI,* SILVIA BERARDI,* GRAZIA PORTALE,*
and NICOLÒ GENTILONI SILVERI*

* Department of Emergency Medicine, A. Gemelli University Hospital, Rome, Italy; and [†] Operative Unit of Emergency Medicine, Castelnuovo Garfagnana Hospital, Lucca, Italy

Conclusion: bedside Us by anterior subcostal tranverse scanning is safe, reliable, fast, easy and reproducible way to assess diaphragm movement

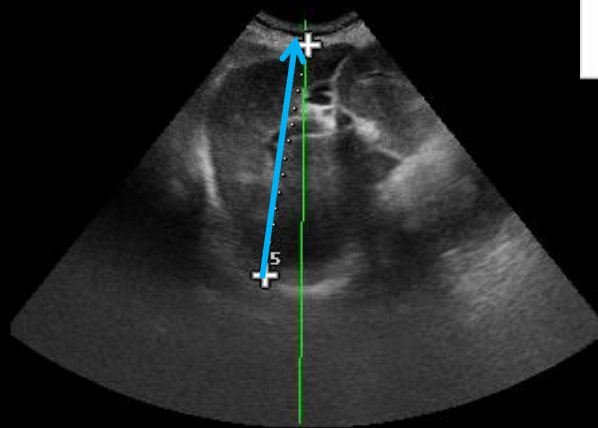


@saote MyLab

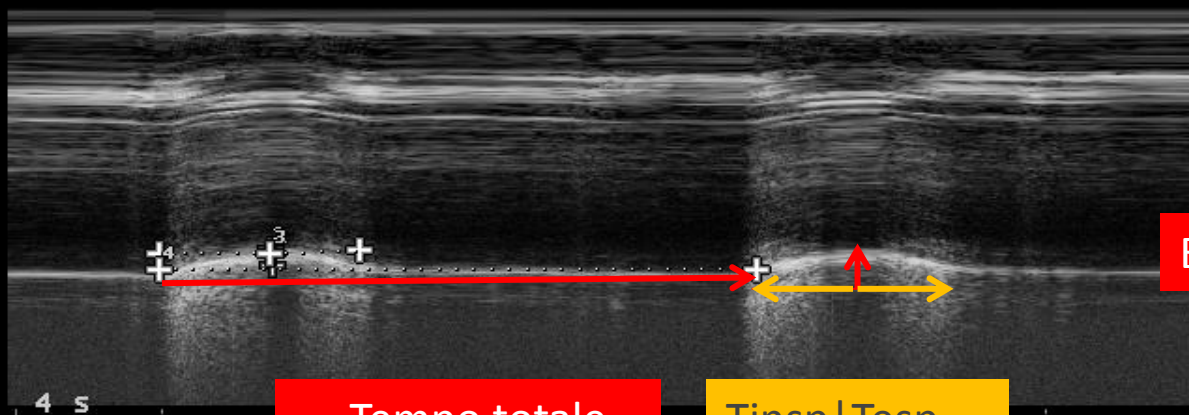
B	F	G	G	46%	
TEI	P	25	cm	XV	1
PRC	15-2-A	PRS	3		
PST	2				

FACTORY CA430

D1	0.96	cm
T2	382	ms
T3	305	ms
T4	2029	ms
D5	13.73	cm



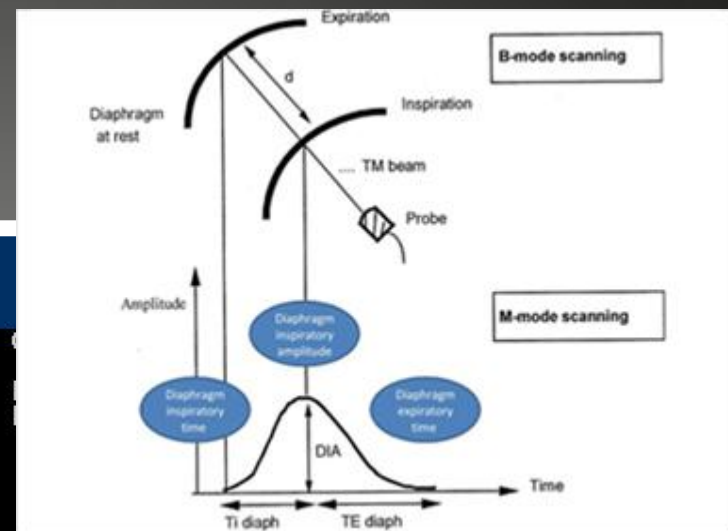
Dome



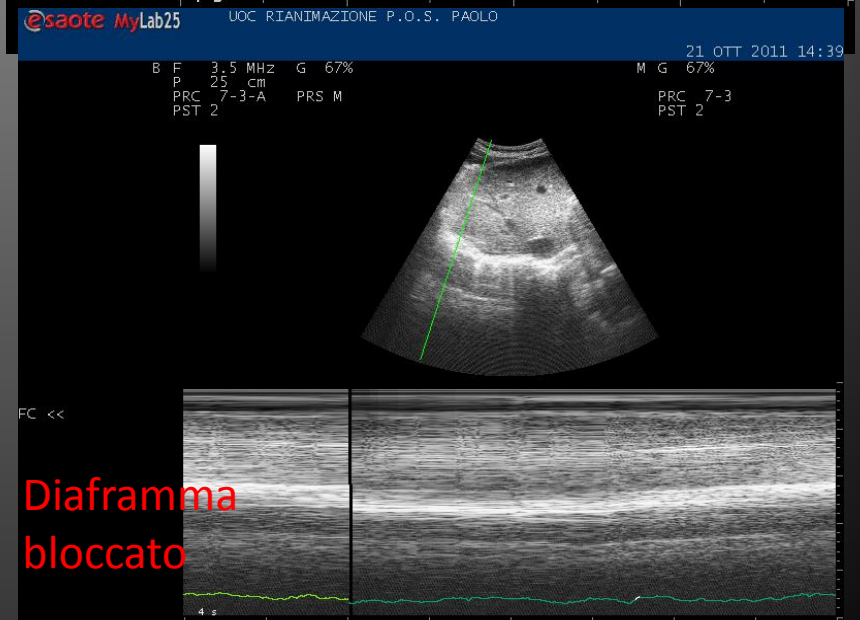
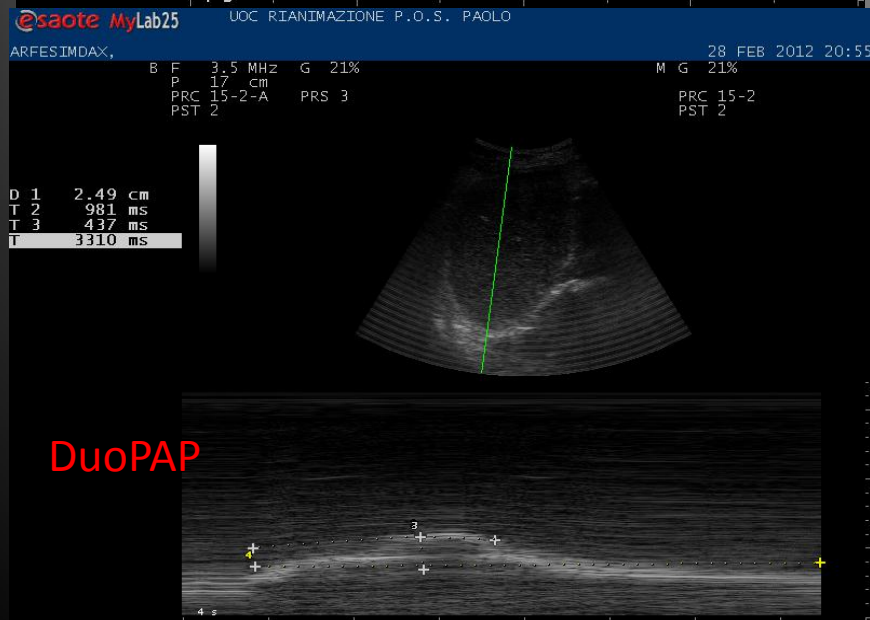
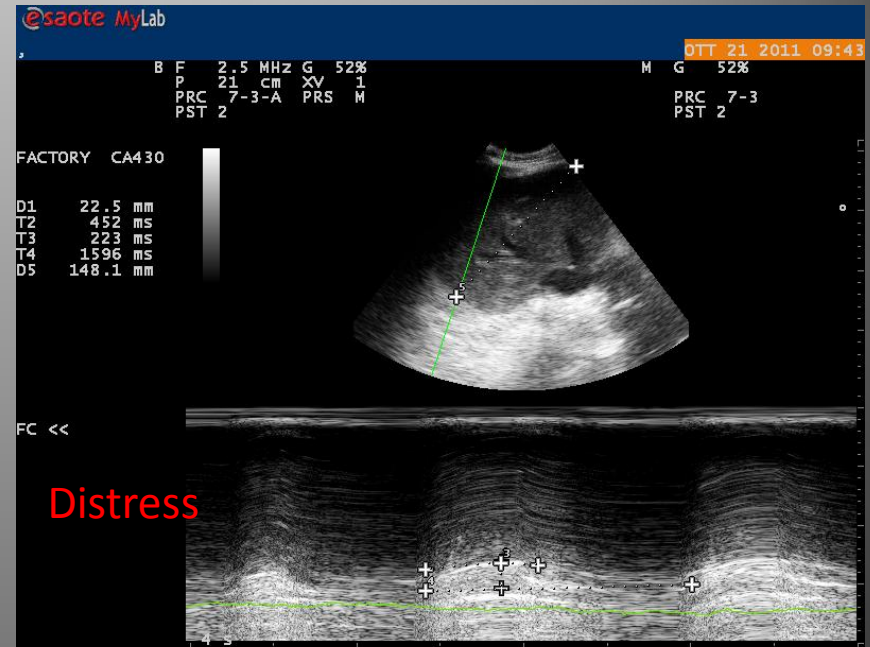
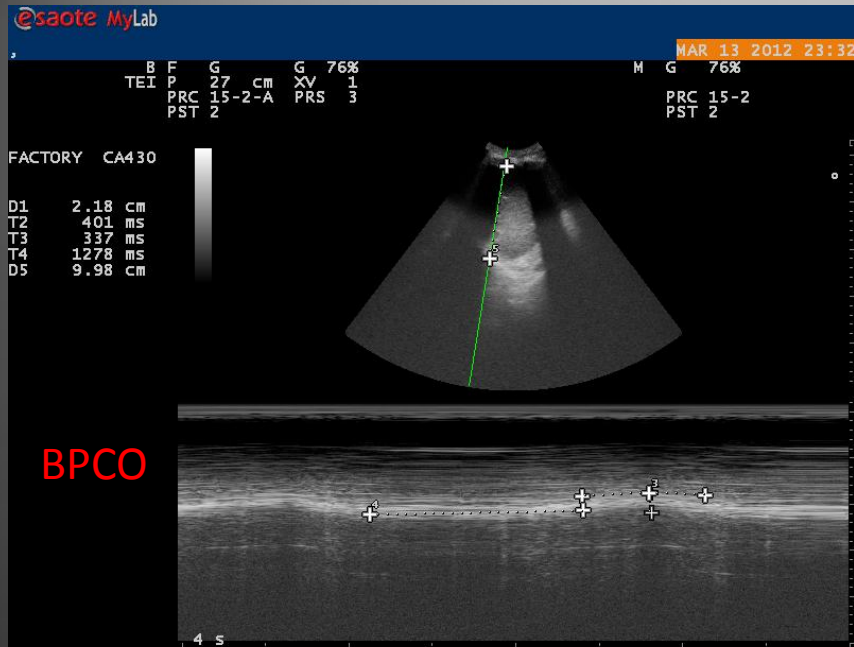
Tempo totale

Tinsp | Texp

E(DIA)

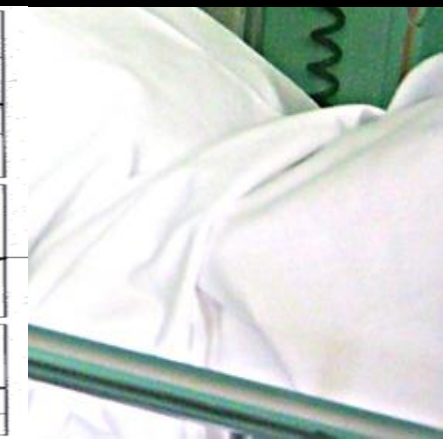
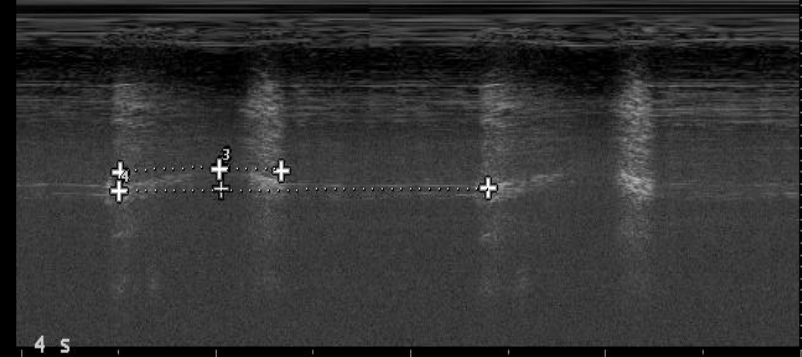
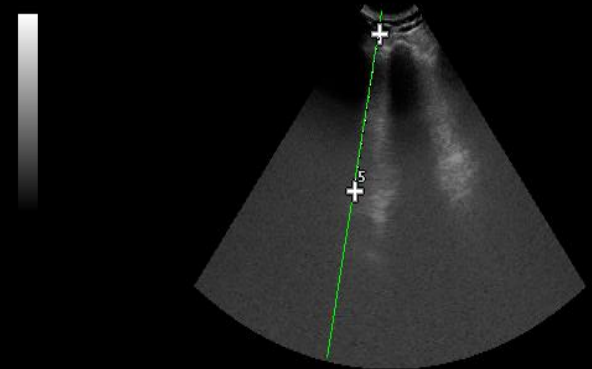


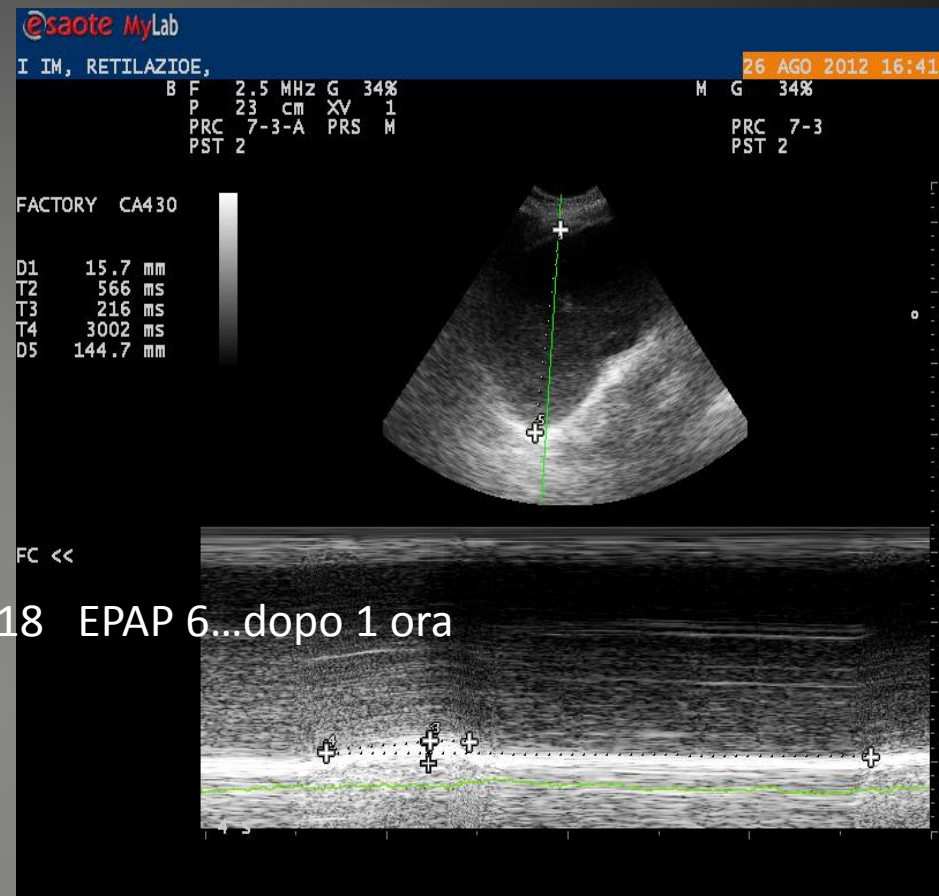
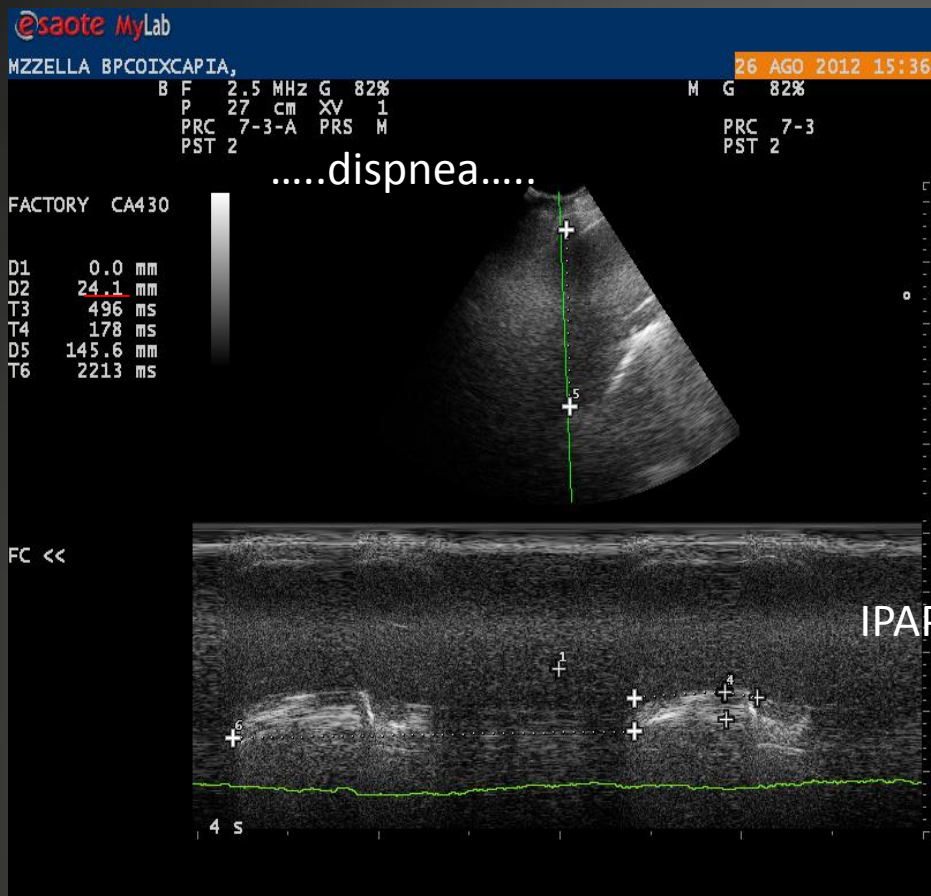
Pattern diaframmatico



M	G	97%
	PRC	15-2
	PST	2

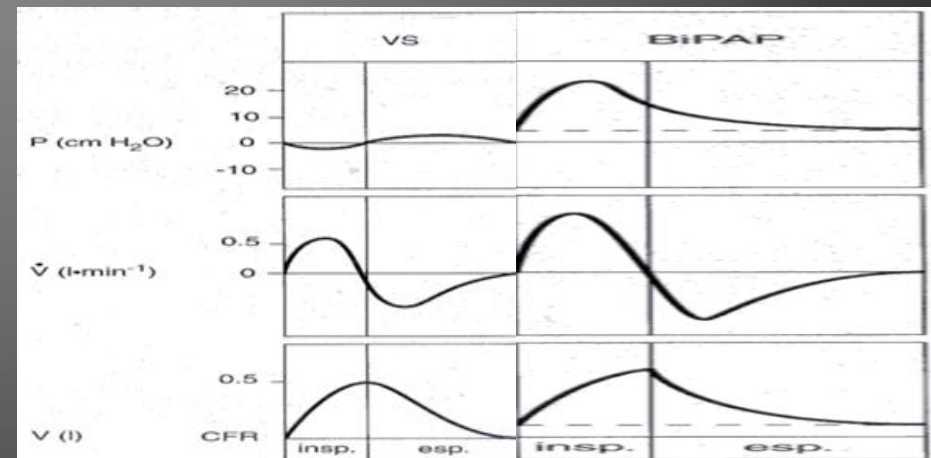
D1	1.71	cm
T2	515	ms
T3	318	ms
T4	1895	ms
D5	13.28	cm



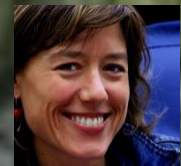


IPAP 18 EPAP 6...dopo 1 ora

pH 7.32, pCO_2 69,
 pO_2 77, Lat 0.4
 HCO_3 35.6, FR=28

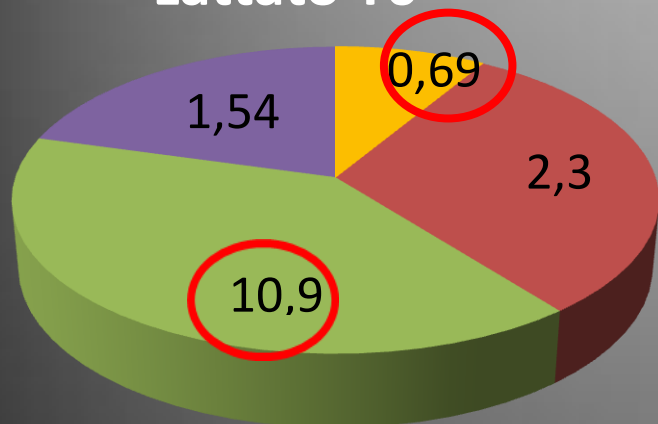


...i nostri dati...

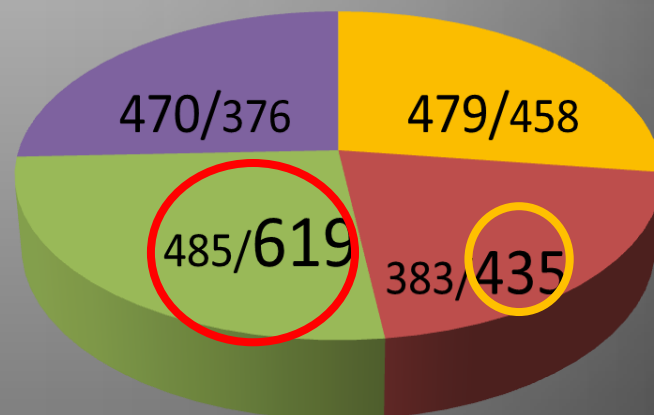


...i primi dati...pazienti con *dispnea* afferenti al PS dei (Tempo zero) (sett-genn 2011)

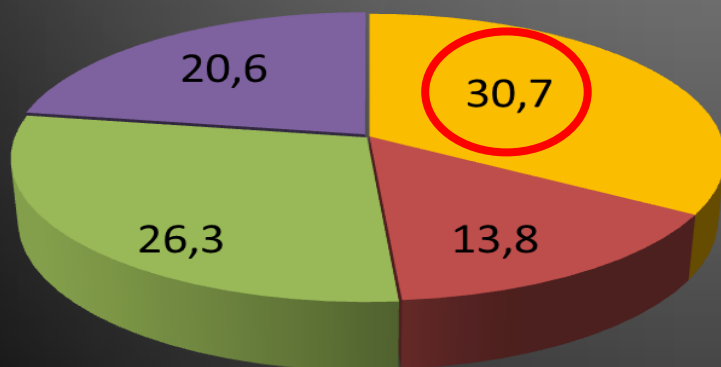
Lattato T0



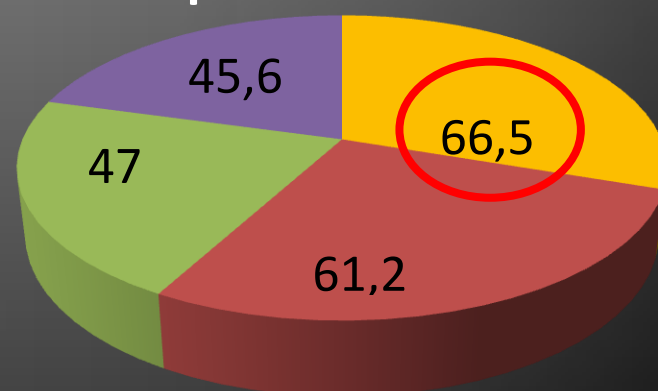
Tinsp/Tesp (msec)



Escursione (mm)



pCO2 T0



■ BPCO ■ Fibrosi ■ CAD ■ Misti

ULTRASOUND EVALUATION OF DIAPHRAGM DURING WEANING FROM NON-INVASIVE VENTILATION IN COPD EXACERBATION

Lucia Morelli, Fabio Giuliano Numis, Roberto Copetti*, Mario Guarino, Francesco Longo, Marina Verrengia, Fernando Schiraldi.

Scopo del lavoro: valutare mediante studio ultrasonografico basilare la cinetica diaframmatica dei pazienti con EPDC ricattizzati afferenti all'Emergenza-urgenza e se una qualsiasi alterazione della stessa possa influenzare la risposta alla NIV e/o il tempo di weaning (Tw).

Metodi: Il nostro studio ha coinvolto 52 pazienti (età 68.25 ± 35.7) con diagnosi di insufficienza respiratoria acuta in EPDC (tipo II) ed indicazione alla NIV. Tutti i pazienti furono sottoposti a tempo zero (T0) ed avvenimenti: Rx Torace (PA e LI), esami ematochimici (comprendenti il proBNP e la PCR), ed inoltre ad esame obiettivo, EGA arterioso, **ecografia cardiopolmonare e diaframmatica** ripetute a 6 e a 24 ore (T6 e T24) dall'inizio della NIV ed al tempo di weaning (Tw). La modalità di ventilazione utilizzata fu la **STUVET** (AIRCO SMART AIR PLUS EVOLUTION) con IPAP20 ed EPAP5 e maschere facciali. Sei pazienti non parteciparono allo studio per la presenza di almeno uno dei criteri esclusione precedentemente stabiliti: un BMI > 30, la presenza di un processo broncopneumonico, fibrosi polmonare, atelettasia, neoplasie polmonari, versamento pleurico > 400cc, cardiopatia ischemica cronica con FE < 35% e/o insufficienza cardiaca acuta con quadro di edema polmonare [1].



Fig 1
Approccio sottoscapolare per lo studio della escursione diaframmatica.

La media del Dome fu di 1.72 ± 0.25 a T0 e 1.96 ± 0.25 al Tw ($p < 0.05$). Il Tw fu di 0.61 ± 0.21 ed al Tw 0.52 ± 0.17 rispettivamente ($p < 0.05$) [1]. La T0 0.32 ± 0.10 e a Tw 0.25 ± 0.07 rispettivamente ($p < 0.01$). Tab 1.

La E fu misurata pari a 2.84 ± 0.75 a T0 e pari a 3.21 ± 0.80 a Tw ($p < 0.05$).

Fu possibile dividere i nostri pazienti in base al Tw in due sottogruppi (non sovrapponibili per score clinico APACHE II): 31 pz (**gruppo E**) che furono sottoposti a NIMV con una media di **27 ore** e 35 pz (**gruppo E**) che furono ventilati per una media di **44 ore**.

La **E** al Tw nel **gruppo E** fu di 3.63 ± 0.32 , mentre nel **gruppo E** fu pari a 2.36 ± 0.29 ($p < 0.001$).

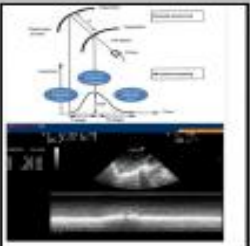


Fig 2 da Ajluni et al mod (Can J Anaesth 1997)
In alcune figure dell'incrocio del fascio US sul diaframma a riposo e durante l'atto inspiratorio, valutazione del dome in base: 1) selezione in B-Mode ed M-Mode in vivo misurazione del Dx (Escursione E), T0ap and T24p (vedi testo).

	Base	6 ore	24 ore	Tw	P
Escursione	1.72±0.25	1.65±0.24	1.91±0.25	1.96±0.25	<0.05
Tw (ore)	0.61±0.21	0.58±0.21	0.54±0.21	0.52±0.17	<0.05
E (cm)	2.84±0.75	2.83±0.81	2.79±0.78	3.21±0.80	<0.01
E (cm/min)	2.84±0.75	2.98±0.75	2.67±0.74	3.11±0.76	<0.05
Tw (ore)	1.60±0.13	1.61±0.23	1.94±0.32	2.36±0.29	<0.001

Tabella della cinetica dei valori cronologici con PLUS diaframmatica basale T0, T6, T24 ed al Tw.

Ecografia diaframmatica: l'esame US venne effettuato da 2 operatori in doppio cieco (Ecografo Mylab 30, Esaote Medical System Genova) con sonde curve 3,5-5 MHz posizionate in sottoscapolare e da trasversalmente a livello della linea medioclavicolare con paziente posto in posizione semisupina (45°) (Fig 1, [2]).

Venne selezionata la media di 3 rilevazioni B-Mode per il **Dome** (punto diaframmatico

Conclusioni
E' noto [3] che il diaframma subisce alterazioni microstrutturali per adattarsi alla fatica respiratoria. Il nostro studio dimostra che i pazienti con EPDC ricattizzati presentano un'alterata motilità diaframmatica rilevabile in modo non invasivo con le metodiche US.

Conclusions: all the patients with **COPD exacerbation** had altered motility of diaphragm (**E**). Patients who showed the major reduction in **E** had **worse respiratory failure** and were hardly **weaned** .

Diaphragmatic dysfunction and mortality in patients with COPD*

Disfunção diafragmática e mortalidade em pacientes portadores de DPOC

Wellington Pereira dos Santos Yamaguti, Elaine Paulin, João Marcos Salge, Maria Cristina Chammas, Alberto Cukier, Celso Ricardo Fernandes de Carvalho

J Brasil Pneumol 2009

- 42 pz con COPD
- 20 LM (<33.9mm), 22 HM (>34mm)
- Follow-up 48mesi (3morti LM)

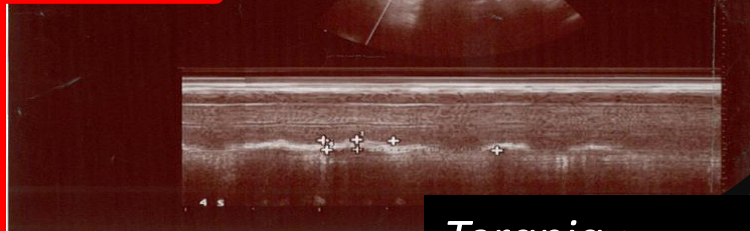
of those deaths occurred in the LM group (15.79%; $p = 0.02$). **Conclusions:** These findings suggest that COPD patients with diaphragmatic dysfunction, characterized by low diaphragm mobility, have a higher risk of death than do those without such dysfunction.

...ritornando a Giovanni...



Viene effettuata anche una valutazione della motilità diaframmatica e...

E 16
Dome 11.7
Tinsp 248
Tesp 273



pH:7.28
FR:35
pCO2:107
FIO2:0.24
pO2:86
Lat:0.6
HCO3:50.3

2 Gennaio.....all'arrivo in PS

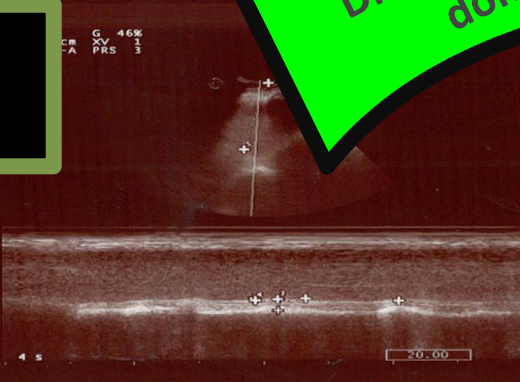
pH:7.37
FR:20
pCO2:81
pO2:56
Lat:1.2
HCO3:46.8

**1 ora
dalla
NIV**

Terapia :
Omeprazolo 20mg,
Metilprednisolone 40mgx2
Levofluoxacina 500mg
Piperacillina+
Tazobactam 13,5mg 24 ore
Acetazolamide 250mgx2
Digossina 0,25mg ev
Enoxaparina 6000U
ASA 250mg
Aloperidolo 2,5mg

**Dimeso in
domi**

E 18
Dome 11
Tinsp 184
Tesp 216

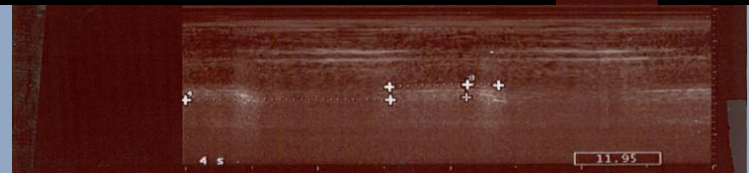


**5 Gennaio
intollerante alla NIV**

**Levosimendan
0.1mcg\Kg\min**

6 Gennaio...
PA120\70mmhg
Fcm80BPM
Apiretico
GCS15, mobilizzato su sedia

pH:7.47
pCO2:63
pO2:63
Lat:1.4
HCO3:45.9
FR30
FIO2 30%



CE

Respiratory muscle fiber remodeling in chronic hyperinflation: dysfunction or adaptation?

Thomas L. Clanton and Sanford Levine

J Appl Physiol 107:324-335, 2009. First published 9 April 2009; doi:10.1152/japplphysiol.00173.2009

Bioenergetic adaptation of individual human diaphragmatic myofibers to severe COPD

Sanford Levine, Chris Gregory, Taitan Nguyen, Joseph Shrager, Larry Kaiser, Neal Rubinstein and Gary Dudley

J Appl Physiol 92:1205-1213, 2002. First published 16 November 2001; doi:10.1152/japplphysiol.00116.2001

Adattamento diaframmatico

Respiratory Research 2008, 9:12

<http://respiratory-research.com/content/9/1/12>

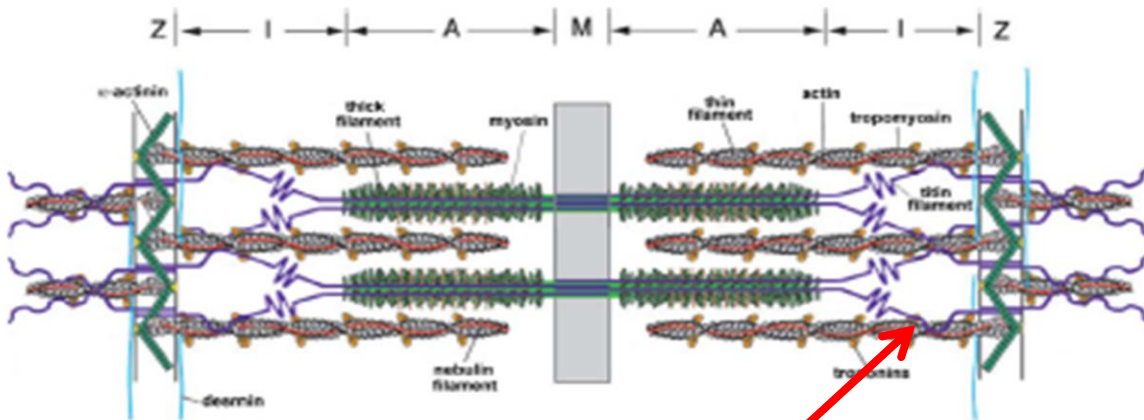


Figure 3
Top: Simplified model of two muscle sarcomeres in parallel. The sarcomere is comprised of the thin (mostly actin) filaments, the thick (mostly myosin) filaments, and the giant filamentous molecule titin. The thin filaments are anchored in the Z-line where they are cross-linked by α -actinin. The thick filament is centrally located in the sarcomere and constitutes the A-band. The myosin heads, or cross-bridges, on the thick filament interact with actin during activation. Titin spans the comeric distance from the Z-line to the M-line, thus forming a third sarcomeric filament. In the I-band region, titin is extensible and functions as a molecular spring that develops passive tension upon stretch. In the A-band titin is inextensible due to strong interaction with the thick filament. Bottom: Electronmicroscopic photograph of the ultrastructural organization of sarcomeres in parallel.

La trasformazione della Titina modifica le caratteristiche VISCOELASTICHE del sarcomero stesso*
*Clanton J Appl Physiol 2009

INTENSIVE CARE MEDICINE



Titin and diaphragm dysfunction in mechanically ventilated rats

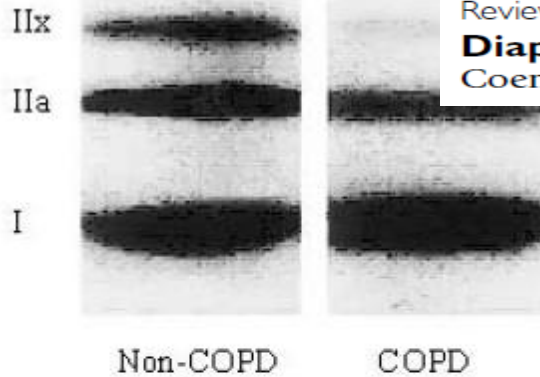
Hees, Hieronymus W. H.; Schellekens, Willem-Jan M.; Andrade Acuña, Gilberto L.; Linkels, Marianne; Hafmans, Theo; Ottenheijm, Coen A. C.; Granzier, Henk L.; Scheffer, Gert-Jan; Hoeven, Johannes G.; Dekhuijzen, P. N. Richard; Heunks, Leo M. A.
Intensive Care Medicine 2012, Volume 38, Number 4, p 702

Jan 2008

Review

Diaphragm adaptations in patients with COPD

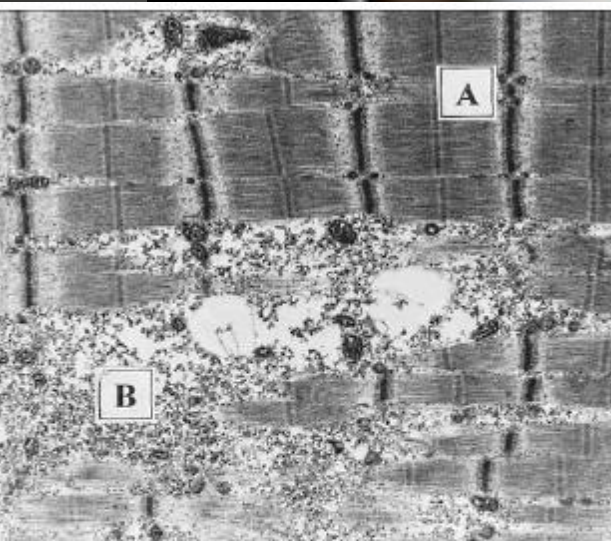
Coen AC Ottenheijm^{*4}, Leo MA Heunks^{1,2,3} and Richard PN Dekhuijzen^{1,3}



Shift verso fibre Tipo I (slow heavy chain) e metabolismo aerobio

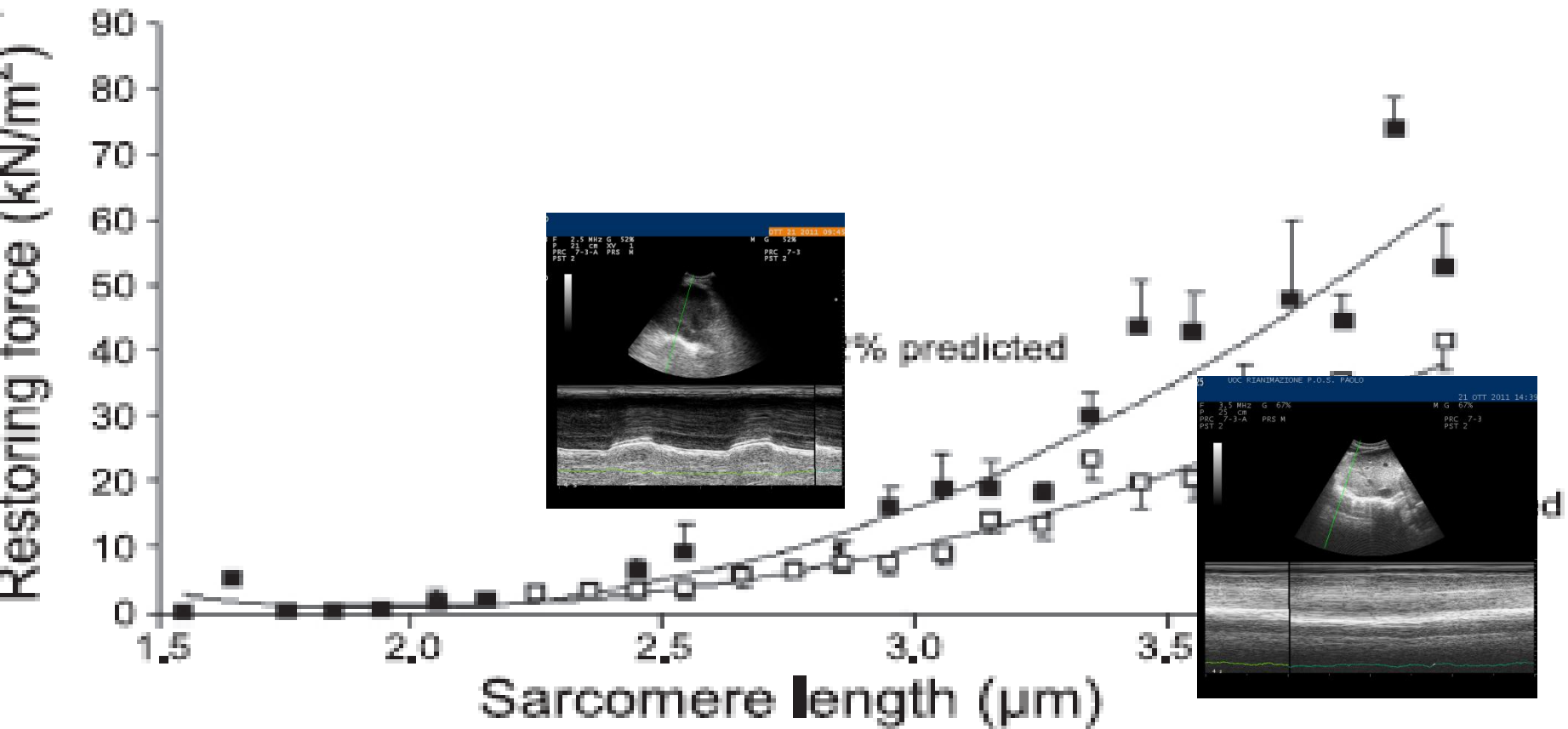
↑Enzimi ossidativi (via aerobica)

↓Sensibilità dell'ATPasi Ca^{++} dip



www.33-Yoga.com

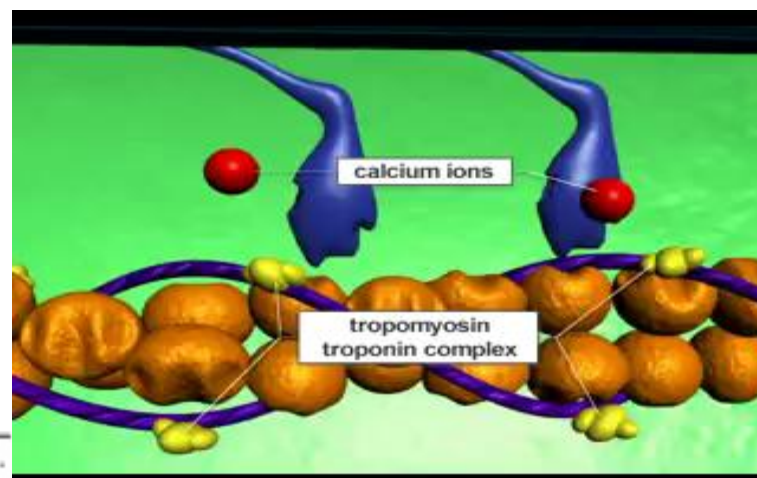
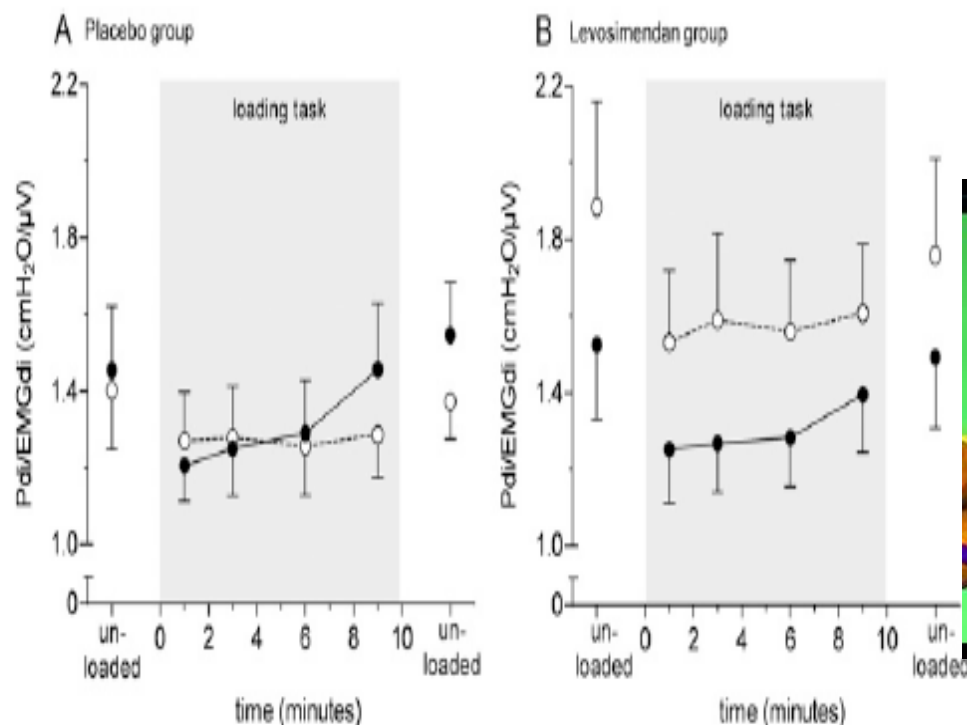
Adattamento diaframmatico



...con Giovanni a che punto della curva eravamo???....
Fibra muscolare da biopsia diaframmatica

(measure of passive elastic properties)

....Lo studio della motilità diaframmatica è risultato utile ed ha guidato le nostre scelte terapeutiche..



The Calcium Sensitizer Levosimendan Improves Human Diaphragm Function

Am J Respir Crit Care Med Vol 185, Iss. 1, pp 90-95, Jan 1, 2012

Jonne Doorduyn¹, Christer A. Sinderby^{2,3}, Jennifer Beck^{3,4}, Dick F. Stegeman^{5,6}, Hieronymus W. H. van Hees⁷, Johannes G. van der Hoeven¹, and Leo M. A. Heunks¹

In conclusion, the present study demonstrates that the calcium sensitizer levosimendan improves contractile function and neuro-mechanical efficiency of the human diaphragm. These findings suggest a new therapeutic approach for patients with acute respiratory muscle dysfunction.

...per concludere...

Un ecografia + **cardiotoracica** e *diaframmatica* dovrebbe effettuarsi appena possibile nel paziente in distress respiratorio:

- stratificare il rischio : **DLM** o **DHM** con US diaframmatica
- monitorare la **NIV** ed il **weaning**
- ottimizzare la terapia : **inotropi**



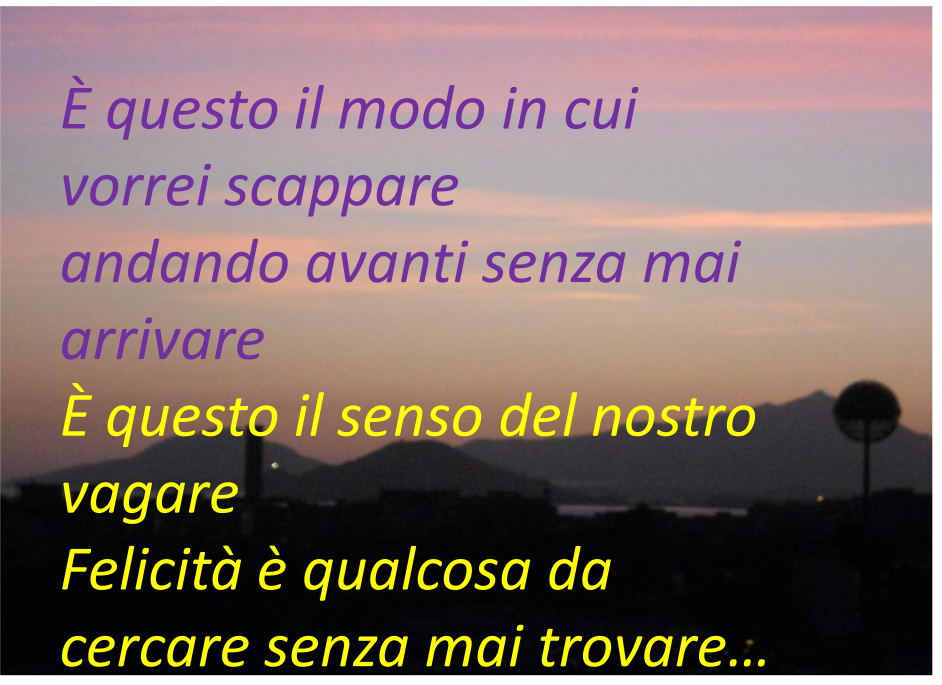
negramaro

TI È MAI
SUCCESSO?

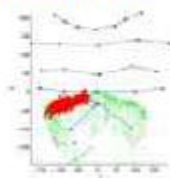
Grazie a tutti voi!



*...ti è mai successo di
guardare il mare
Fissare un punto
all'orizzonte e dire*



*È questo il modo in cui
vorrei scappare
andando avanti senza mai
arrivare
È questo il senso del nostro
vagare
Felicità è qualcosa da
cercare senza mai trovare...*

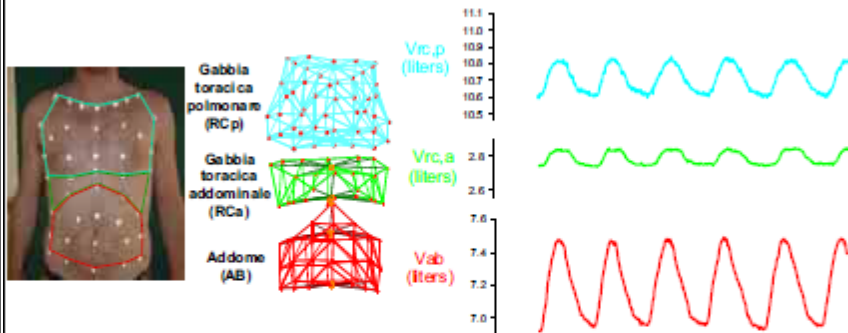


Prospettive future ??



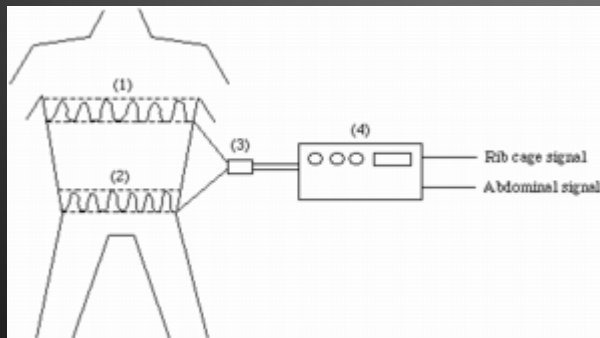
Cosa misura la OEP? 4. Volumi compartimentali

25

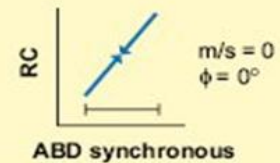
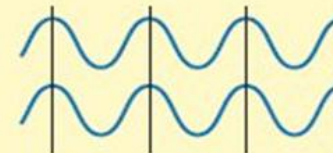


A. Aliverti - Plethysmografia Opto-Elettronica

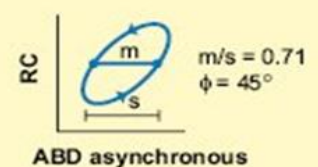
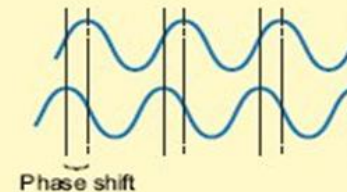
Anno Accad



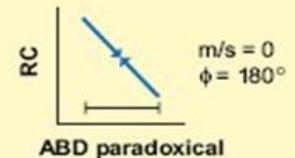
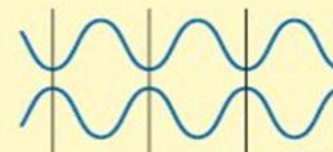
Rib cage
Abdomen



Rib cage
Abdomen



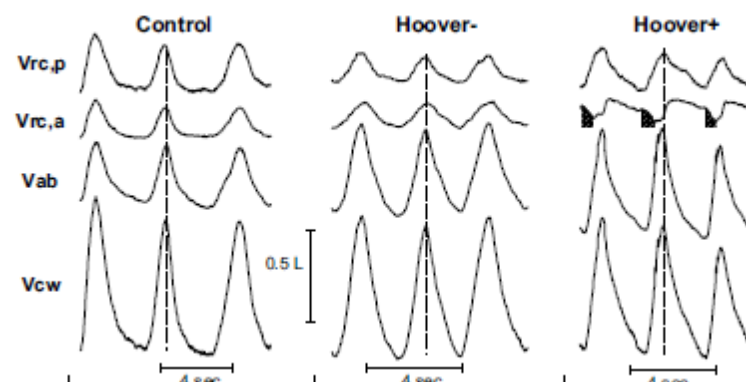
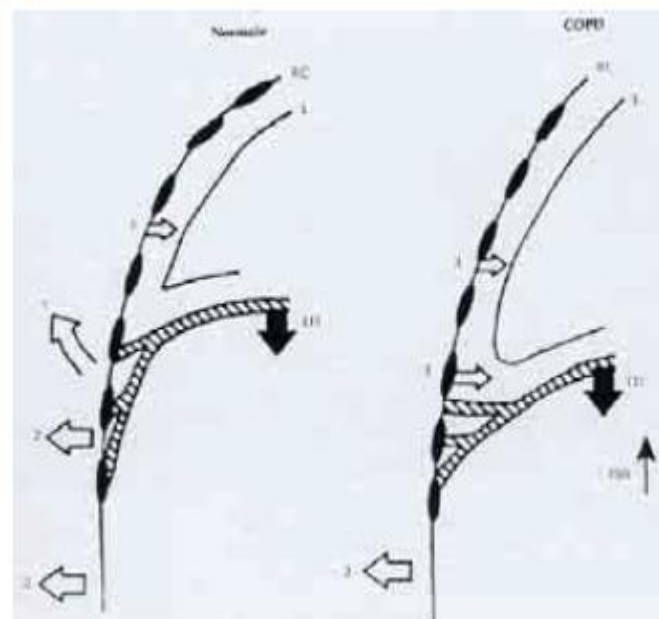
Rib cage
Abdomen



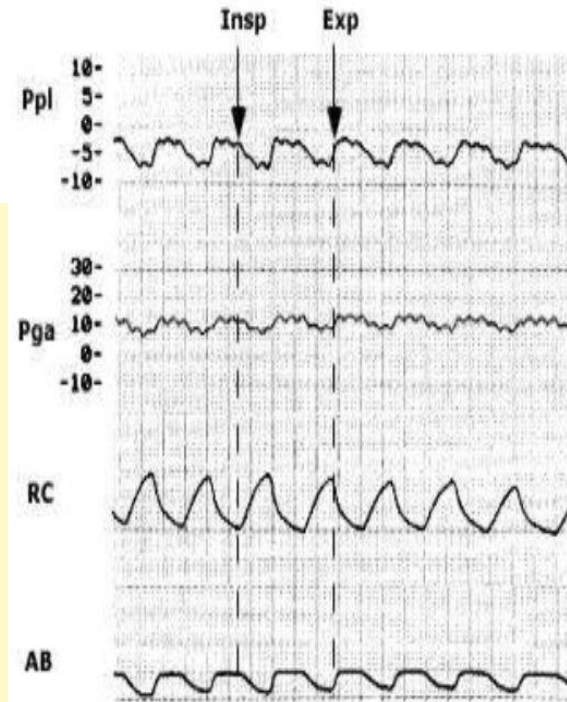


Distorsione della gabbia toracica nei COPD: segno di Hoover

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Transdiaphragmatic pressure



Pleural Pressure:
balloon at the
lower third of
the esophagus

Gastric Pressure:
balloon in the
stomach

Rib Cage
movement

Abdominal
wall
movement

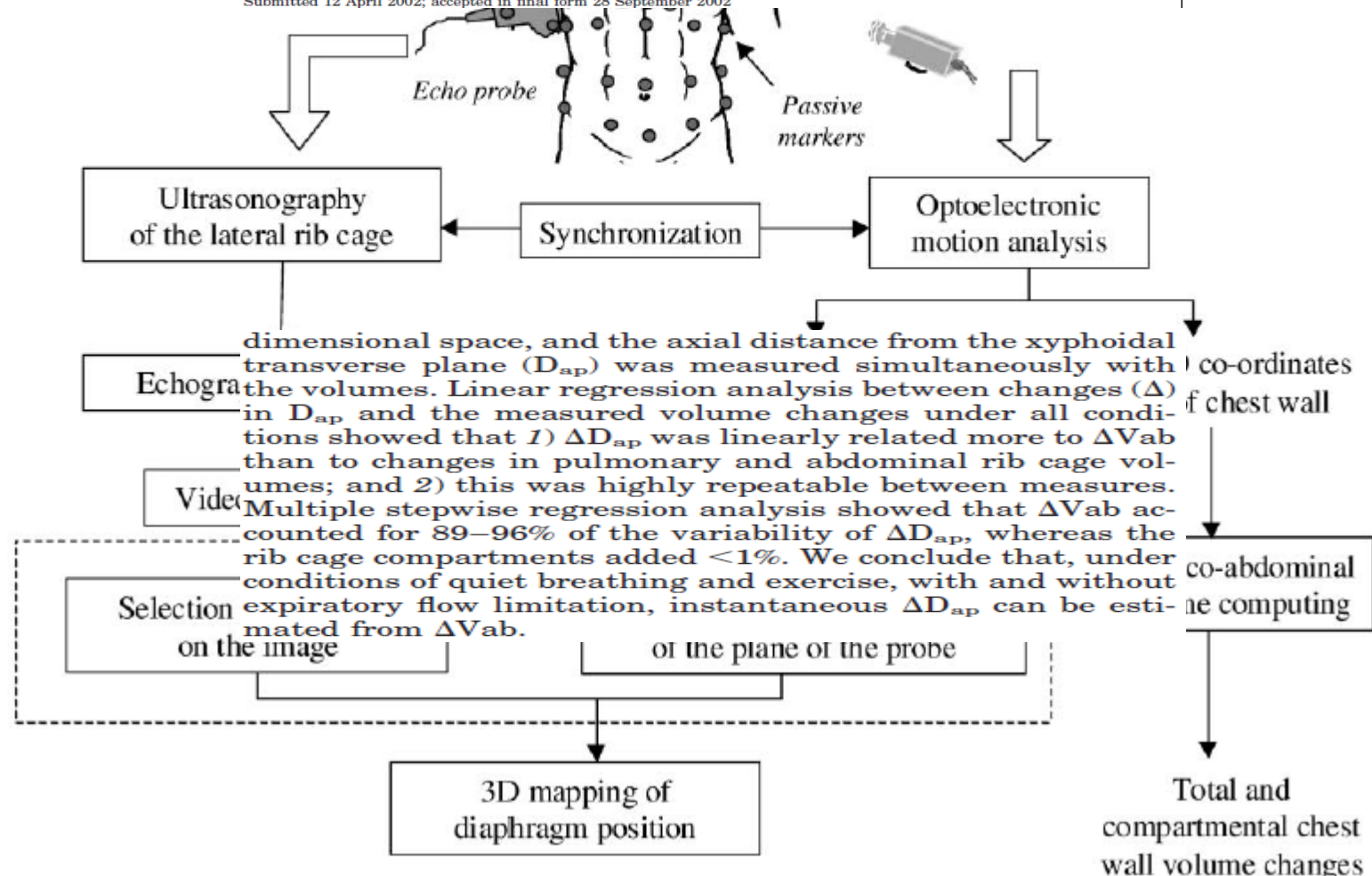
Real-time tracing of esophageal pressure as a reflection of pleural pressure (Ppl) and abdominal pressure as a reflection of gastric pressure (Pga) in a patient with bilateral diaphragmatic paralysis. Decreased intrathoracic pressure (more negative Ppl) on inspiration (Insp) is associated with an abnormal decrease in gastric pressure (more negative Pga). At the same time, there is outward displacement of the rib cage (upward deflection of RC) with a paradoxical decrease in abdominal volume (downward deflection of AB).

A Chest wall kinematic determinants of diaphragm length by optoelectronic plethysmography and ultrasonography

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Submitted 12 April 2002; accepted in final form 28 September 2002



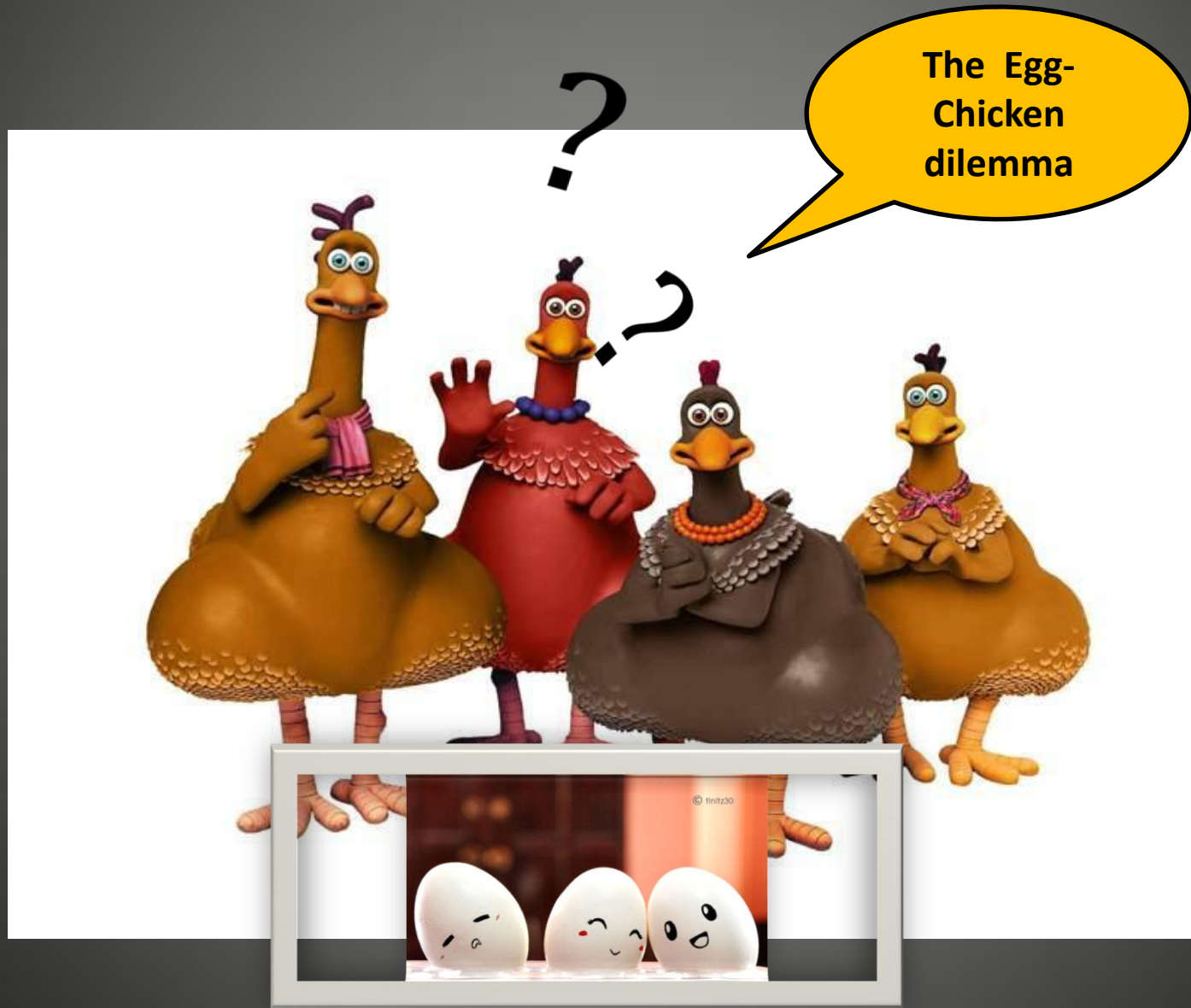
Optoelectronic Plethysmography in Intensive Care Patients

ANDREA ALIVERTI, RAFFAELE DELLACÀ, PAOLO PELOSI, DAVIDE CHIUMELLO, ANTONIO PEDOTTI,
and LUCIANO GATTINONI

Dipartimento di Bioingegneria, Politecnico di Milano, Italy; Centro di Bioingegneria, Fondazione Don Gnocchi IRCCS e Politecnico di Milano, Italy;
and Istituto di Anestesia e Rianimazione, Università di Milano, Ospedale Maggiore IRCCS, Milano, Italy

volume maneuvers. The discrepancy from the ideal zero line was -2.1 ± 48.3 ml. Abdominal contribution to inspired volume was greater for normal subjects than for PSV patients ($63 \pm 11\%$ versus $43 \pm 14\%$, $p < 0.001$). It decreased with V_T for normal subjects ($48.5 \pm 15\%$, $p < 0.05$), whereas it increased for CPPV patients ($61 \pm 10\%$, $p < 0.05$). No significant distribution differences were found between 5 and 25 cm H₂O PSV. We conclude that optoelectronic plethysmography is a feasible technique able to provide unique data on the distribution of chest wall volume changes in intensive care patients.

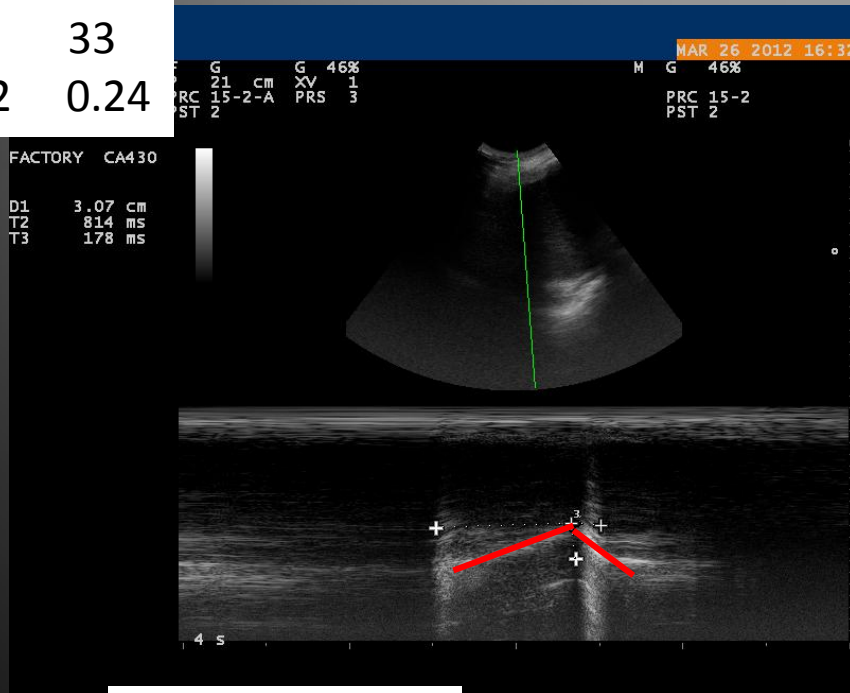
Adattamento diaframmatico



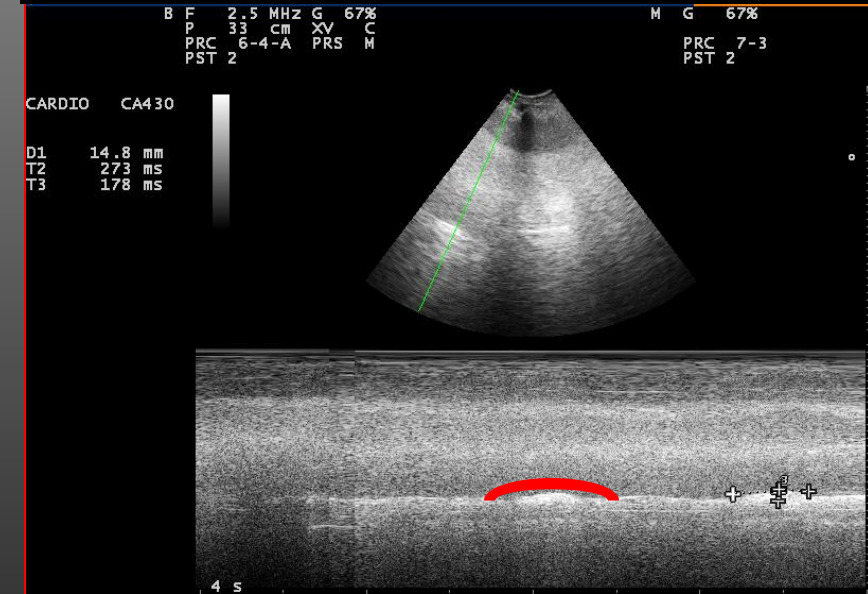
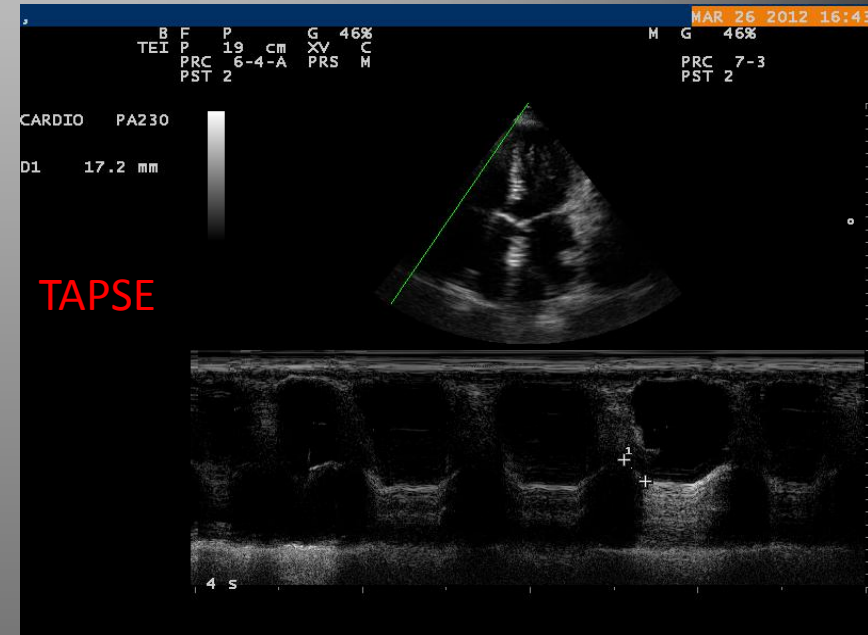
.....Angelina a76

pH 7.36
pCO₂ 50
pO₂ 152
Lat 1.1
HCO₃ 28
FR 33
FIO₂ 0.24

- BPCO
- CAD cronica
- Dispnea dalla nottata



BILEVEL
PSV-ST IPAP 18
EPAP 6
FIO₂ 3lit min



Influence of Diaphragmatic Mobility on Hypercapnia in Patients with Chronic Obstructive Pulmonary Disease

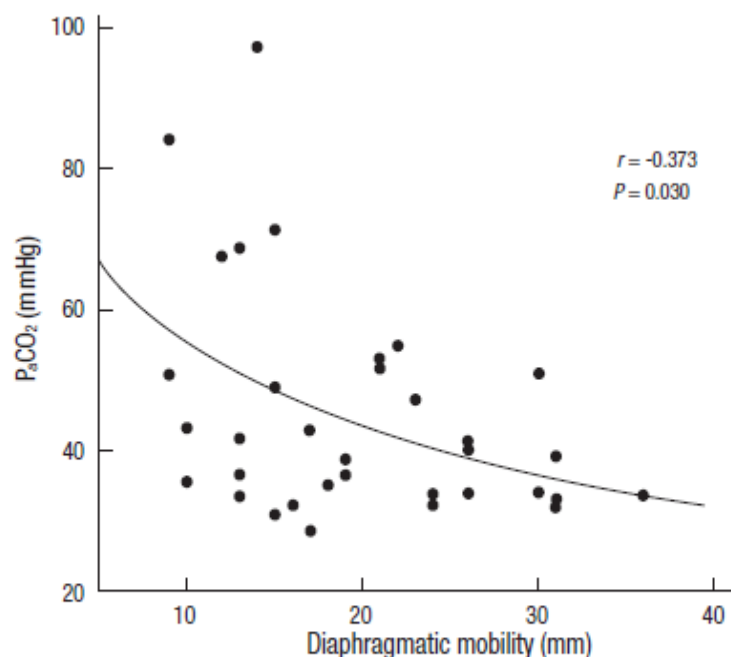


Fig. 2. The relationship between diaphragmatic mobility and the P_aCO_2 . There was a negative linear correlation between the two measurements ($r = -0.373$, $P = 0.030$). P_aCO_2 , arterial carbon dioxide tension.

