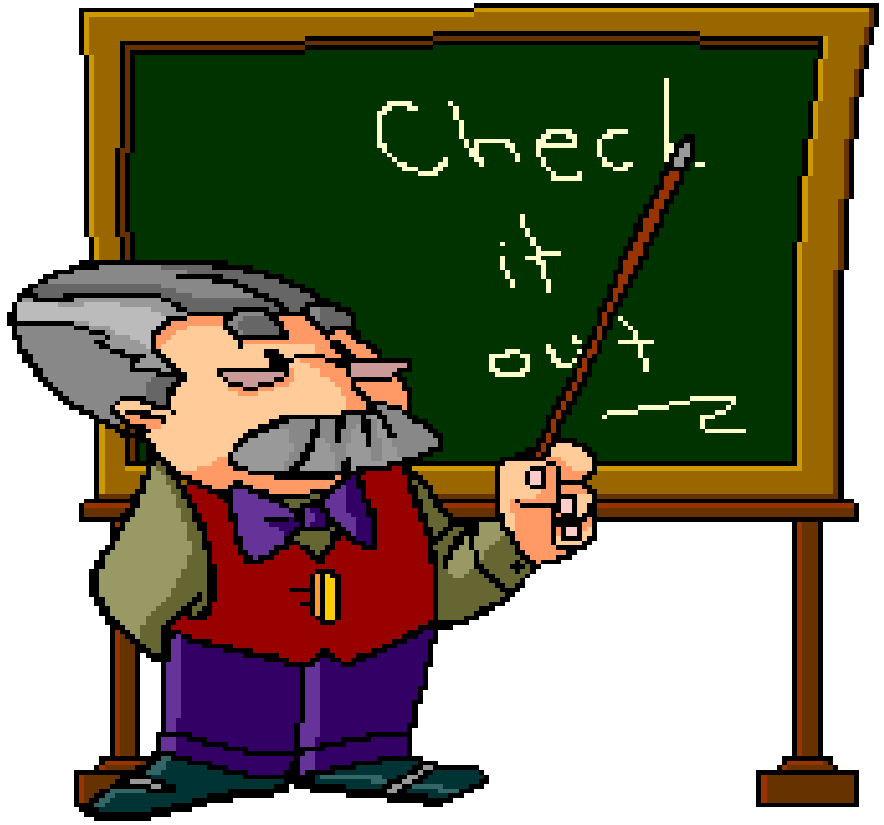
INDICAZIONI ALLA VENTILAZIONE MECCANICA NON INVASIVA



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Cos'è un ventilatore?

Un ventilatore meccanico è un apparecchio che insuffla aria all'interno di un polmone generando un incremento di volume.

Si sostituisce in parte o completamente all'azione dei muscoli respiratori la cui efficacia può essere alterata per patologia primitiva o secondaria alle alterazioni della meccanica polmonare ed ha quindi fra i suoi scopi quello di alleviare la fatica muscolare

PROVVEDIMENTO TERAPEUTICO CHE NON SOSTITUISCE LA TERAPIA FARMACOLOGICA

Invasiva: l'interfaccia è costituita dalla tracheostomia o tubo endotracheale

Non invasiva : I'interfaccia è una maschera o un casco

SOCIETÀ ITALIANA DI GERONTOLOGIA E GERIATRIA

Medical Progress

Advances in Mechanical Ventilation

Martin J. Tobin, M.D.

N Engl J Med, Vol. 344, No. 26 · June 28, 2001

The objectives of mechanical ventilation are primarily to decrease the work of breathing and reverse life-threatening hypoxemia or acute progressive respiratory acidosis.

INDICAZIONE ALLA NIV NELLE FORME IPERCAPNICHE : GUIDELINES 2016

Thorax. 2016 Apr;71 Suppl 2:ii1-35. doi: 10.1136/thoraxjnl-2015-208209.

BTS/ICS guideline for the ventilatory management of acute hypercapnic respiratory failure in adults.

Davidson AC[1], Banham S[1], Elliott M[2], Kennedy D[3], Gelder C[4], Glossop A[5], Church AC[6], Creagh-Brown B[7], Dodd JW[8], Felton T[9], Foëx B[10], Mansfield L[11], McDonnell L[12], Parker R[13], Patterson CM[14], Sovani M[15], Thomas L[16]; BTS Standards of Care Committee Member, British Thoracic Society/Intensive Care Society Acute Hypercapnic Respiratory Failure Guideline Development Group, On behalf of the British Thoracic Society Standards of Care Committee.

Recommendations

24. For most patients with AECOPD, the initial management should be optimal medical therapy and targeting an oxygen saturation of 88–92% (Grade A).

Use of oxygen with an unrestricted fractional concentration of oxygen in inspired air (FiO2) was common and associated with increased need for ventilation (22·2% for unrestricted oxygen strategy vs 9·4% for restricted oxygen strategy) and mortality (11·1% vs 7·2%).

25. NIV should be started when pH<7.35 and pCO_2 >6.5 kPa (48,75 mmHg), RR>22 apm persist or develop despite optimal medical therapy (Grade A).

ed ancora pensate alla NIV se….

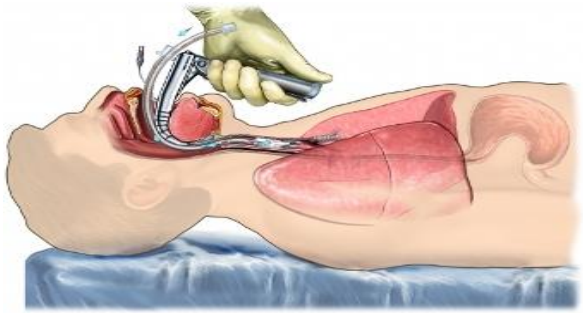
Dispnea ingravescente con uso evidente dei mm accessori e/o dissincronismo toraco-addominale

Ipossiemia nonostante la somministrazione di ossigeno ad elevate concentrazioni (FiO2>60% con OF)

Pazienti in cui il ricorso alla ventilazione invasiva non e' disponibile o indicato (tumori in fase terminale, età molto avanzata,) oppure pazienti che rifiutano l'intubazione.

Ci sono condizioni in cui non dovremmo neanche iniziare

- **Quando l'insufficienza respiratoria è accompagnata da instabilità cardio-vascolare nonostante la somministrazione di inotropi(aritmie minacciose per la vita , PAsistolica <70 mmHg)**
- **Arresto cardiaco**
- **Arresto respiratorio (RR<12 apm!!!)**
- **Coma soprattutto se non ipercapnico (GCS<8)**
- **Clearance delle secrezioni bronchiali inefficace**
- **pH?????? (<7.15???)**
- **Necessità di proteggere le vie aeree**
- **Ostruzione delle vie aeree superiori**
- **PNX non drenato**



MA SOPRATTUTTO SE NON SAPPIAMO COSA STIAMO FACENDO ....

PRIMA DI INIZIARE FACCIAMOCI DUE DOMANDE !!!

***Panel 2:* Prognostic indices to be considered prior to initiation of acute non-invasive ventilation in acute hypercapnic respiratory failure**

Cause of acute hypercapnic respiratory failure

- Favourable: chronic obstructive pulmonary disease, extra-pulmonary restriction, and cardiogenic pulmonary oedema
- Adverse: pulmonary fibrosis and isolated pneumonia

Stable state

- Poor performance status
  - Unable to leave home unassisted
  - Requires help washing and dressing
- High comorbidity burden
- Low body-mass index

Severity of acute illness

- Blood gas abnormalities
  - Late development of acute hypercapnic respiratory failure after admission
  - Coexistent metabolic acidaemia or low base excess
  - Severe acidaemia (pH <7·25)
- Other organ failure or impairment
- Consolidation
- Observations including: respiratory rate >30, hypotension (particularly if unresponsive to fluid resuscitation), and low Glasgow Coma Scale (<11)
- Blood results including: eosinopenia (<50 cells per µL), raised urea, and hypoalbuminaemia
- Inability to clear secretions

Indices listed are associated with worse outcome unless otherwise stated. No single index in isolation should preclude a trial of non-invasive ventilation.

Vantaggi della NIV

Precoce supporto ventilatorio

Facilità di applicazione e rimozione

Applicazione intermittente

Possibilità di sospensione in qualsiasi momento

Conservazione dei meccanismi di difesa delle vie respiratorie

Il pz può bere, mangiare e comunicare

Il pz può collaborare ed effettuare fisioterapia

Riduce la necessità di sedazione

Complicanze della NIV

Segni e sintomi	Possibili cause
• Discomfort al contatto della pelle o guasto dell'interfaccia	Eccessiva pressione Frizione, reazione o irritazione della pelle
• Distensione gastrica, aspirazione e vomito	Deglutizione di aria Scarso adattamento Eccessiva insufflazione Mangiare o bere in prossimità della NIV
•Crampi, sensazione di formicolio	iperventilazione che causa alcalosi respiratoria
•Difficoltà a dormire	Ansia
•Claustrofobia	Ventilazione inadeguata
✓Abrasione nasale, secchezza, congestione e riniti	✓Aria secca esalata dalla macchina
✓Irritazione oculare, congiuntivite	✓Perdite aeree intorno alla maschera
✓Otalgia e/o sinusite	✓Pressione eccessiva della macchina
✓Dispnea atipica	✓Perdita di pressione di supporto e riduzione Vt
✓Dolore dentale	✓Pressione esercitata dalla maschera buccale
✓Dolore toracico, dispnea	✓Possibile pneumotorace

Knebel A. et al. Heart Lung 1997;26:307-316

Cosa idealmente mi aspetto ad 1 ora

- FR < 30/minuto
- Miglioramento del distress respiratorio: riduzione della dispnea, riduzione del reclutamento della muscolatura accessoria
- Sensorio: miglioramento o stabilità
- Sp02 > 90%
- Pa02/FiO2: miglioramento > 50, meglio 100
- Miglioramento del pH rispetto al basale
- riduzione della pCO2 del 20% rispetto al basale

HO BISOGNO DI ASPETTARE 1 h????

Table 5 Monitoring NIV

Patient
Respiratory rate
Other vital signs
Dyspnoea/accessory muscle use/abdominal paradoxical breathing
Level of consciousness
Comfort with the interface
Collaboration
Ventilator parameters
Tidal volume (>4 mL/Kg: 6–7 mL/Kg) and minute ventilation
Air leakage volume (<0, 4 L/s or < 25 L/min)
Pressure support and PEEP settings
Asynchrony (ineffective efforts, auto-triggering, double-triggering, short/long cycle)[a]
Trigger/slope (ramp)/Inspiration time/expiration settings
Auto-PEEP
Alarms (apnoea or high respiratory rate, low/high minute ventilation, others)
Gas exchange
Continuous pulse-oximetry (SpO_2)
Arterial or venous blood gas samples[b]

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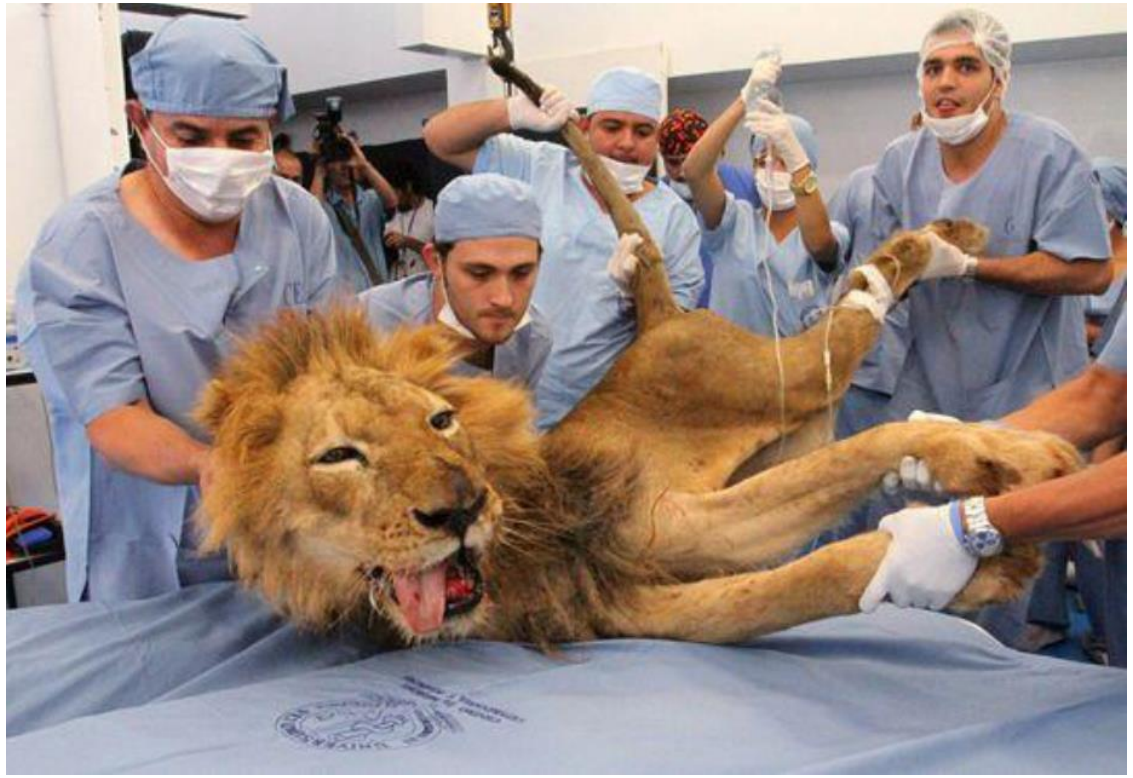
LA CHIAVE DEL SUCCESSO….

The key issue is optimal synchronization between the patient's spon taneous breathing and the ventilator. Air leakage is often involved in cases of asynchrony, which may be reduced by one or more of adjusting the mask, shortening inspiration time, changing pressure support by steps of 2 cmH2O or moving inspiratory and expiratory triggers (when available) by steps of 5–10% or finally, giv ing sedation.

Patent-ventilator interaction during noninvasive ventilation. Respir Care 2011;56:153–165
Patient-ventilator asynchrony during non-invasive ventilation for acute respiratory failure: a multicer study. Intensive Care Med 2009;35:840–846.

Cercare ed ottenere la collaborazione del paziente ….



SEDAZIONE O NON SEDAZIONE

in patients with hypoxaemic respiratory failure, continuous infusion of a single sedative agent (either remifentanil, dexmedetomidine, or propofol) is effective and safe in selected patients at risk of NIV failure due to mask discomfort and agitation.

NB dexmedetomidine causes minimal respiratory depression!

Intensive Care Med 2007; **33:** 82–87.

Anesth Analg 2008; **107:** 167–70.

Intensive Care Med 2010; **36:** 1675–80.

Devlin showed that intravenous administration of dexmedetomidine immediately after NIV initiation in patients with acute respiratory failure did not improve NIV tolerance or maintain a desired target level of Sedation

Chest 2014; **145:** 1204–12.

dexdor® dexmedetomidine

ALLERT:

- rischio di farlo diventare un approccio routinario

Nb: l'agitazione può avere una causa "organica"

- Perde di vista la valutazione neurologica
- Si confonde l'intolleranza con l'inadeguato setting del ventilatore e adeguata scelta dell'interfaccia

Nb: solo in ambiente monitorato

L'importante è finire…. (prima o poi) e come finire…

When to stop

Non-invasive ventilation is usually stopped when a satisfactory recovery has been achieved (usually 2–5 h in ACPE) or conversely, if there are signs of NIV failure, requiring EI (*Table 5*). After mid- or long-term use of NIV (>24 h), a weaning[83] period is often carried out, by decreasing F_IO_2, PEEP, and ventilation settings progressively. Early mobilization may shorten this process. With F_IO_2 <0.5 and flow rate < 20 L/m, HFNC can be safely replaced by COT.

è inutile insistere e ritardare l'intubazione se :

Peggioramento livello di vigilanza (associato a peggioramento della CO2 causa di fallimento della NIV nel 45% dei pazienti in cui la NIV fallisce)

Agitazione psicomotoria (!)

Instabilità emodinamica

MOF

Vomito

Incapacità di gestire le secrezioni

Intolleranza dell'interfaccia

Peggioramento in 1-2 h o mancato miglioramento in 4-6 ore

se dopo 1-2 h: SaO2 < 90%, PaO2 < 60 mm Hg, pH < 7,30, P/F < 180, FR > 30/m

Mai riposare sugli allori….

Early improvement in pH is strongly associated with survival, whereas late failure (deterioration after 24 h of normalisation of pH with recurrent respiratory acidaemia) is associated with frailty and poor survival.

Risk factors of failure
- Before initiation
  - Lung infection
  - Altered mental status
  - Hypotension
  - High severity scores
  - Copious secretions
  - Extremely high respiratory rate
  - Severe hypoxaemia in spite of high F_IO_2
- After initiation
  - Inappropriate ventilator settings
  - Unfitting interface
  - Excessive air leakage
  - Asynchrony with the ventilator
  - Poor tolerance to NIV
- After 60–90 min
  - No reduction in respiratory rate or carbon dioxide
  - No improvement in pH or oxygenation ($\downarrow SpO_2$ or $\downarrow PaO_2/FiO_2$)
  - Signs of fatigue
  - Neurological or underlying disease impairment

Incidence and causes of non-invasive mechanical ventilation failure after initial success. *Thorax* 2000; **55:** 819–25

BTS audit reports 2010 to 2013. British Thoracic Society, 2018.

Quando il paziente peggiora….

Corretto settaggio
Corretta interfaccia

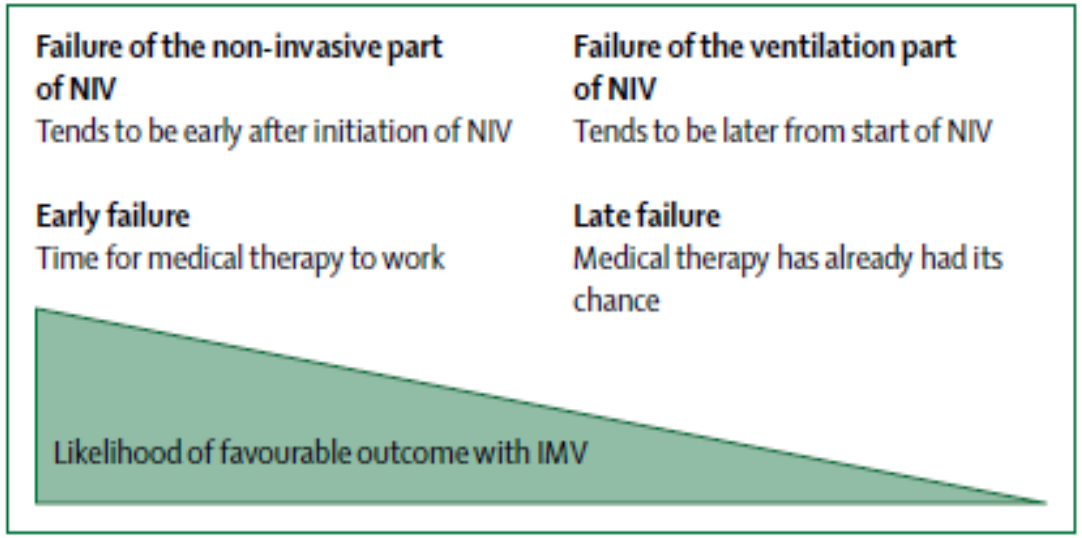


Figure: **The effects of NIV failure on the likelihood of a successful outcome with IMV over time**
NIV=non-invasive ventilation. IMV=invasive mechanical ventilation.

Malattia sottostante grave!!!!

Vale la pena intubarlo???
C'è una condizione reversibile sottostante il peggioramento?

Considerazioni sul fallimento della NIV

However, several studies have shown that invasive ventilation of patients after failed NIV results in a poor prognosis. Although this poor prognosis might relate to delays in intubation in some cases, in others it could be that a population with a poor prognosis .

A volte la risposta alla NIV può orientare ..comunque andrebbe valutato il dnr sempre dopo un trial di NIV (???)

. Hospital noninvasive ventilation case volume and outcomes of acute exacerbations of chronic obstructive pulmonary disease. *Ann Am Thorac Soc* 2016; **13:** 1752–59.

Outcomes associated with invasive and noninvasive ventilation among patients hospitalized with exacerbations of chronic obstructive pulmonary disease. *JAMA Intern Med* 2014; **174:** 1982–93.

Outcomes of noninvasive ventilation for acute exacerbations of chronic obstructive pulmonary disease in the United States, 1998–2008. *Am J Respir Crit Care Med* 2012; **185:** 152–59.

Noninvasive ventilation for acute exacerbations of chronic obstructive pulmonary disease: “Don’t think twice, it’s alright!”. *Am J Respir Crit Care Med* 2012; **185:** 121–23.

Chi ventilo in caso di insufficienza respiratoria acuta ?

BPCO riacutizzata

Edema polmonare acuto

Scompenso acuto in paziente con sindrome da ipoventilazione da ogni causa

Polmoniti acquisite in comunità soprattutto nel BPCO , e nell'immunodepresso

Acute lung injury- ARDS

Polmonite da Covid

Trauma toracico

Malati sottoposti a chirurgia

Attacco asmatico acuto non responsivo a terapia medica (?????)…solo se siete molto bravi!

Svezzamento dalla ventilazione invasiva

SOCIETÀ ITALIANA DI GERONTOLOGIA E GERIATRIA

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Martin J. Tobin, M.D.

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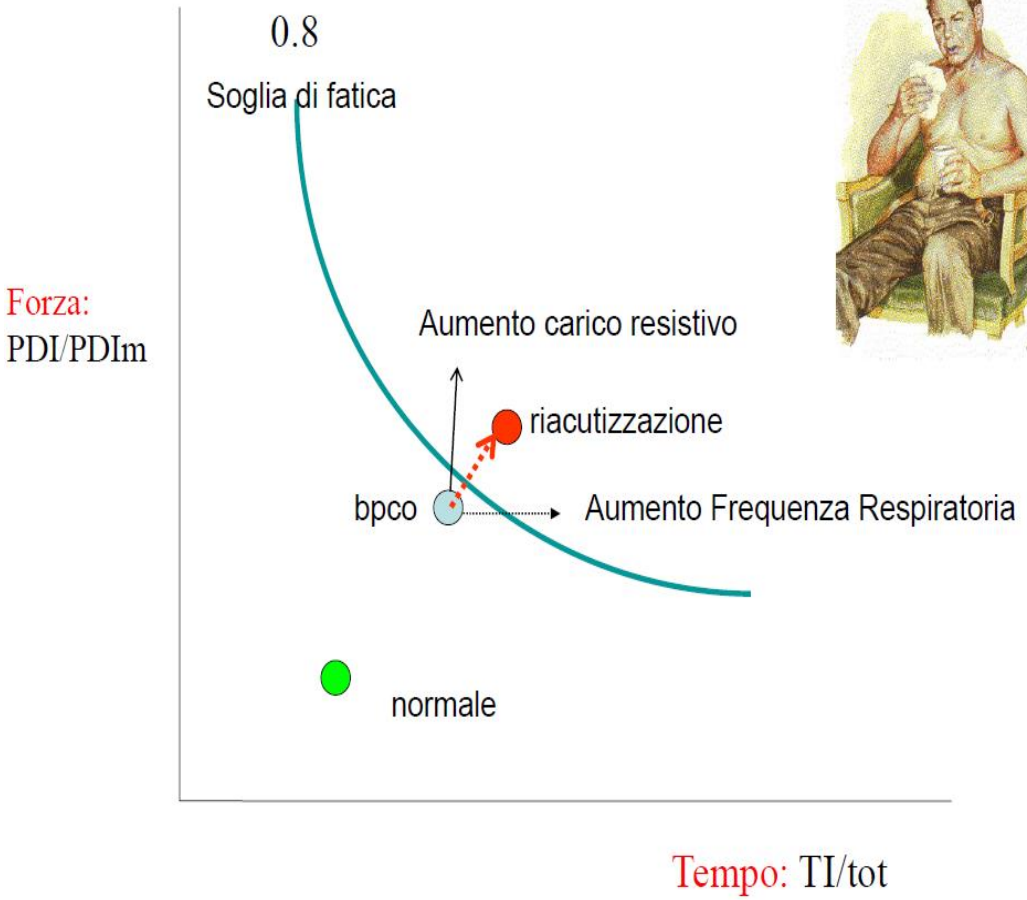
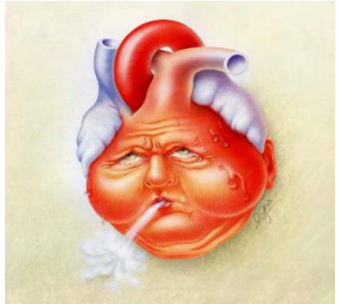
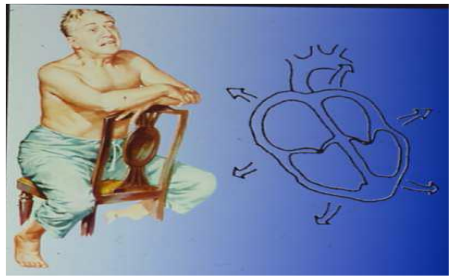
Razionale della NIV nella BPCO riacutizzata

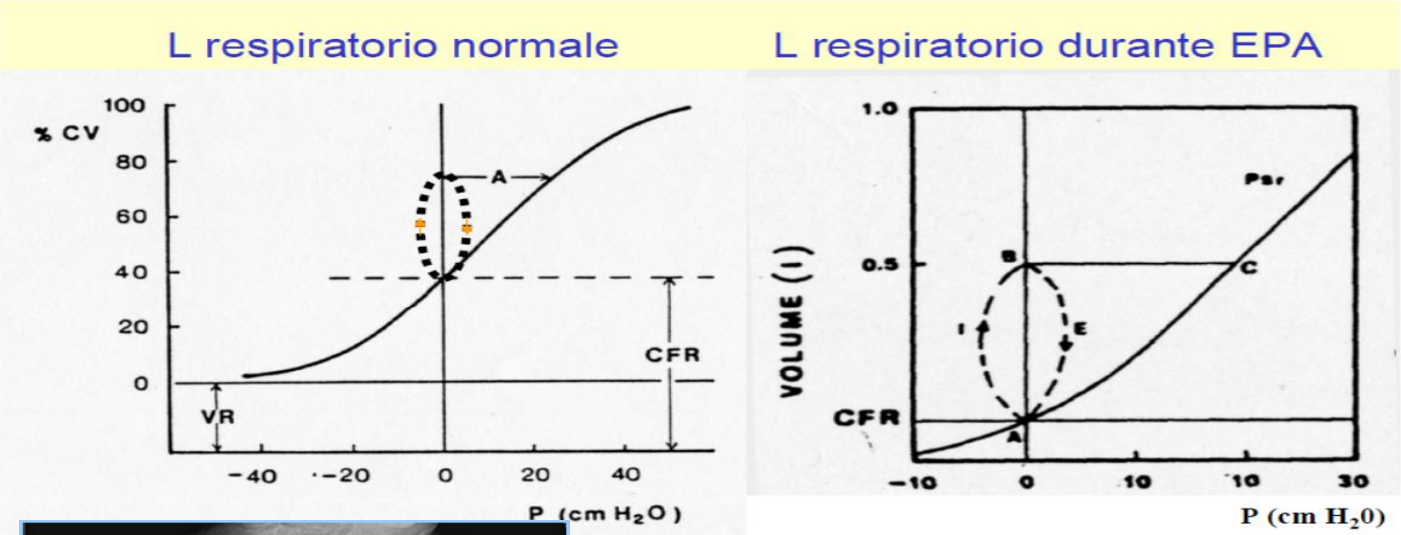


<u>Concetto di livello soglia di fatica muscolare respiratoria</u> :
Condizione caratterizzata dalla incapacità di un muscolo di sviluppare forza o velocità e/o forza contrattile in seguito ad aumentato carico di lavoro, reversibile con il riposo.



Razionale della ventilazione nell'edema polmonare





Accumulo di liquidi extravascolare (imbibizione alveolare , scarsa diffusione alveolo-capillare di ossiegeno, collasso alveolare e bronchiolare progressivo dalle basi agli apici quindi ostruzione al flusso, airtrapping e generazione di una PEEPi)

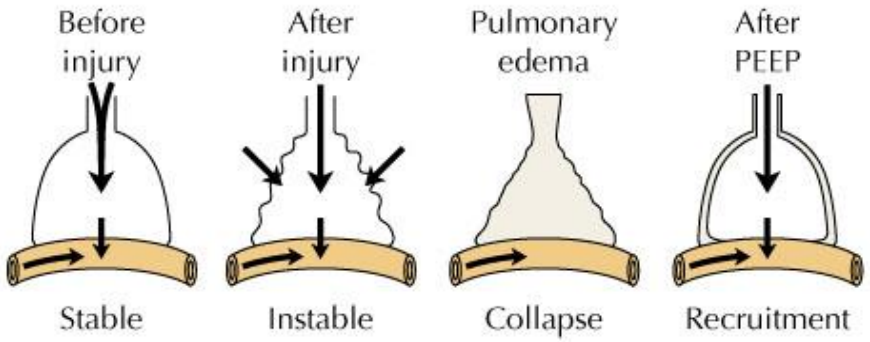
Diminuisce la compliance polmonare , diminuisce la CFR

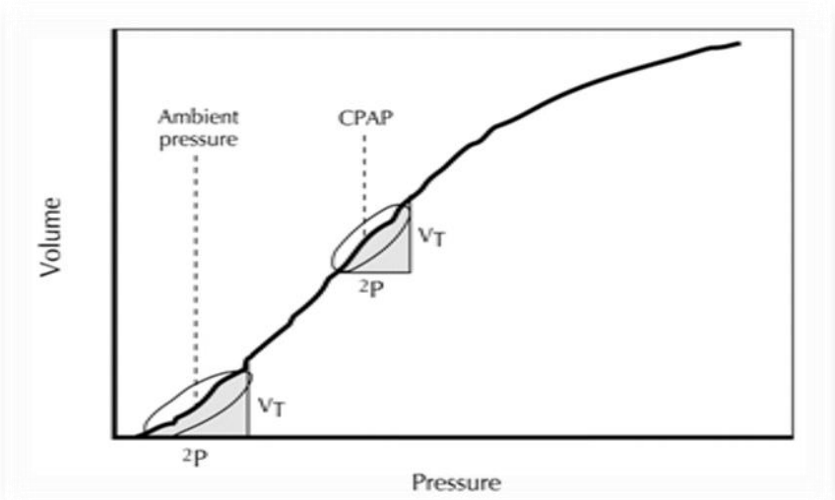
Pattern respiratorio con volumi piccoli e frequenti

La pressione positiva espiratoria

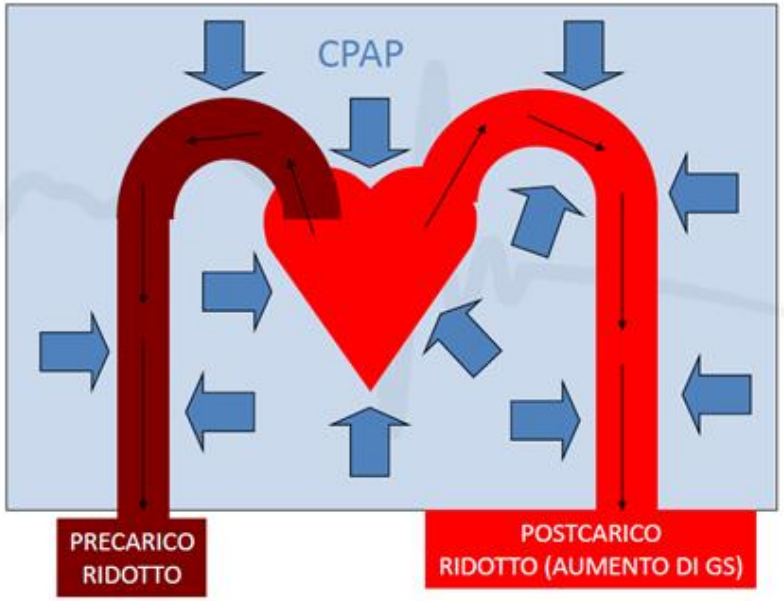
Aumenta il volume alveolare di fine espirazione aiutando lo spostamento di liquidi dagli alveoli allo spazio interstiziale , riducendo lo shunt e migliorando l' ossigenazione consentendo di ridurre la FiO2 a dosi non tossiche

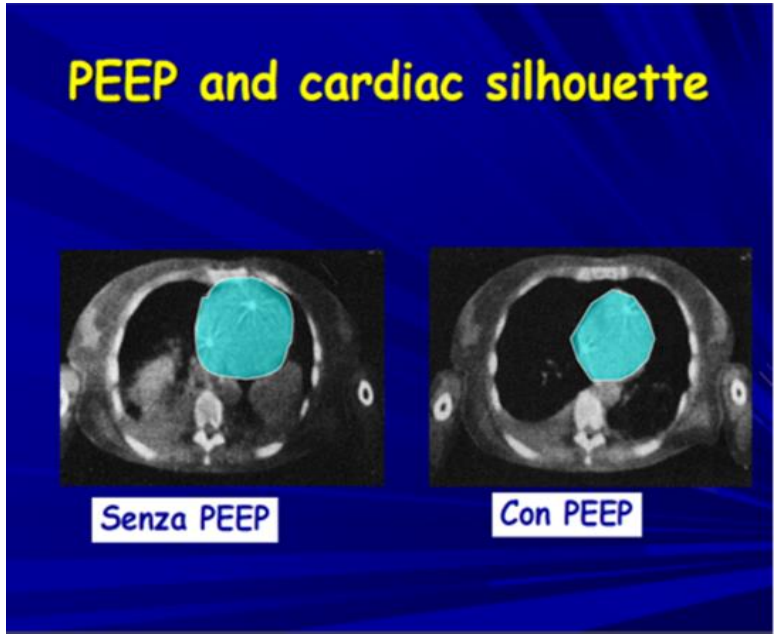
Riduce il lavoro respiratorio per aumento della compliance polmonare





PEEP : EFFETTI EMODINAMICI





Migliora la funzionalità cardiaca in pazienti con cardiomiopatia dilatativa attraverso la riduzione del volume cardiaco «compresso « dall'aumento di volume polmonare, la riduzione del ritorno venoso per aumento della pressione intratoracica e la riduzione del lavoro respiratorio quindi del consumo di O2

BTS GUIDELINE

Non-invasive ventilation in acute respiratory failure

British Thoracic Society Standards of Care Committee

Thorax 2002;**57**:192–211

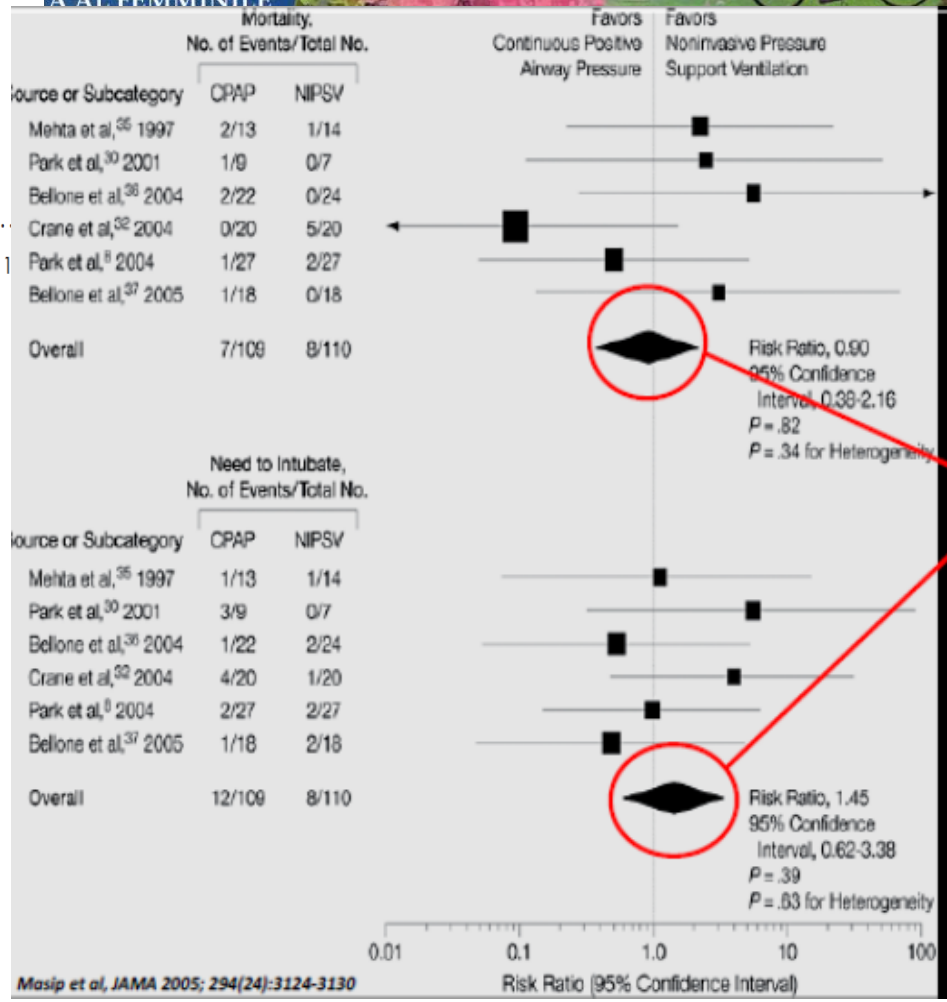
- *CPAP has been shown to be effective in patients with cardiogenic pulmonary oedema who remain hypoxic despite maximal medical treatment. NIV should be reserved for patients in whom CPAP is unsuccessful.* [**B**]

ESC European Society of Cardiology — European Heart Journal (2018) **39**, 17–25 doi:10.1093/eurheartj/ehx580 — **REVIEW**

Heart failure/cardiomyopathy

Indications and practical approach to non-invasive ventilation in acute heart failure

….CPAP is a simpler technique that may be preferred in low-equipped areas like the pre-hospital setting, while NIPSV may be preferable in patients with significant hypercapnia.



CPAP e PSV: metodiche complementari

? NON INTERCAMBIABILI

Negli anziani con scompenso cardiaco

Ulteriori fattori complicanti il quadro clinico :

- debolezza muscolare (presente comunque 30-50% dei casi) causata da alterazioni fisiologiche correlate all'invecchiamento : riduzione dei capillari muscolari e riduzione della capacità ossidativa mitocondriale.
- una precoce esauribilità in caso di iperventilazione per riduzione dell'endurance muscolare causata da sarcopenia con perdita del tessuto muscolare per riorganizzazione dei miofilamenti , riduzione del numero di fibre muscolari soprattutto di tipo II e delle unità motorie a contrazione rapida, sostituzione delle fibre muscolari con collagene
- frequente malnutrizione per deficit vitaminici, soprattutto del gruppo B , in parte anche secondari al'uso di diuretici ad alte dosi

High Prevalence of Respiratory Muscle Weakness in Hospitalized Acute Heart Failure Elderly Patients. PLoS One 2015; 10: e0118218.

Sui pazienti anziani l'effetto sulla mortalità è meno evidente

survival. The effects of this technique on long-term mortality, especially in older patients, is unclear. The mid-term to long-term prognosis of older patients admitted for acute pulmonary oedema is often poor, with a high hospital mortality.[99,100] NIV is often used as a ceiling technique for these patients without offering intubation. For those discharged alive after treatment

Noninvasive ventilation in acute cardiogenic pulmonary edema. *N Engl J Med* 2008; **359:** 142–51.

Altre applicazioni

ARF after major surgery

After thoracic surgery, pulmonary complications like ARF represent the first cause of death with a mortality rate of 60% - 80%.

Kutlu H, Ann Thorac Surg 2000

After abdominal surgery, postop hypoxemia complicates between 30% - 50% of cases.

ARF may occur early in the postop course, requiring mechanical ventilation in 8% - 10% of patients.

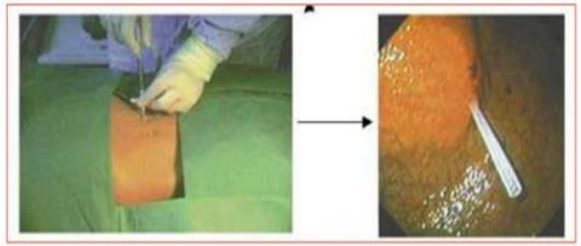
La NIV riduce la reintubazione e la mortalità
I risultati sono sovrapponibili a quelli dell'ossigeno ad alti flussi nella cardiotoracica
NB: escludere che ci siano anastomosi e leak

Stephan F. JAMA 2015
Jaber S,. Chest 2005;
Squadrone V,. JAMA 2005;
Auriant I, AmJ Respir Crit Care Med 2001

Ed ancora ….

Noninvasive ventilation allows gastrostomy tube placement in patients with advanced ALS

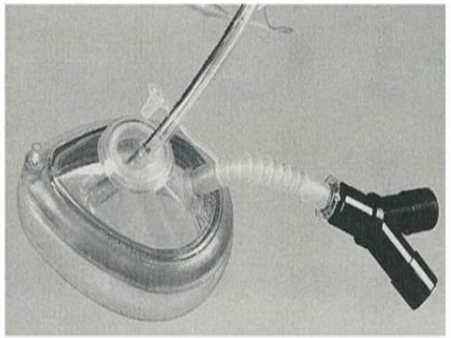
Neurology. 2001; 56:413-4



The use of NIV for ventilatory support during percutaneous endoscopic gastrostomy (PEG) tube placement is described in five patients with advanced ALS, four having significant bulbar symptoms.

No respiratory complications occurred in any of these patients, who were considered to be at high risk for PEG placement

NIV - bronchoscopy



In patients with ARF, hypersecretion and pneumonia both diagnostic but also therapeutic conventional unassisted fiberoptic bronchoscopy may worsen pulmonary status and even be contraindicate

La NIV nel DO NOT INTUBATE

Noninvasive positive pressure ventilation in critical and palliative care settings: Understanding the goals of therapy*

J. Randall Curtis, MD, MPH; Deborah J. Cook, MD; Tasnim Sinuff, MD, PhD; Douglas B. White, MD; Nicholas Hill, MD; Sean P. Keenan, MD, MSc(Epid); Joshua O. Benditt, MD; Robert Kacmarek, PhD, RRT; Karin T. Kirchhoff, RN, PhD, FAAN; Mitchell M. Levy, MD; the Society of Critical Care Medicine Palliative Noninvasive Positive Pressure Ventilation Task Force

Tipo 1: NIV come supporto vitale senza limiti

Tipo 2: pz che rifiutano l'intubazione

Tipo 3 : pz che vogliono solo il controllo del sintomo dispnea e non incrementare la sopravvivenza per comunicare con i pazienti o attendono di salutare i pz o sbrigare degli affari

Crit Care Med 2007 Vol. 35, No. 3

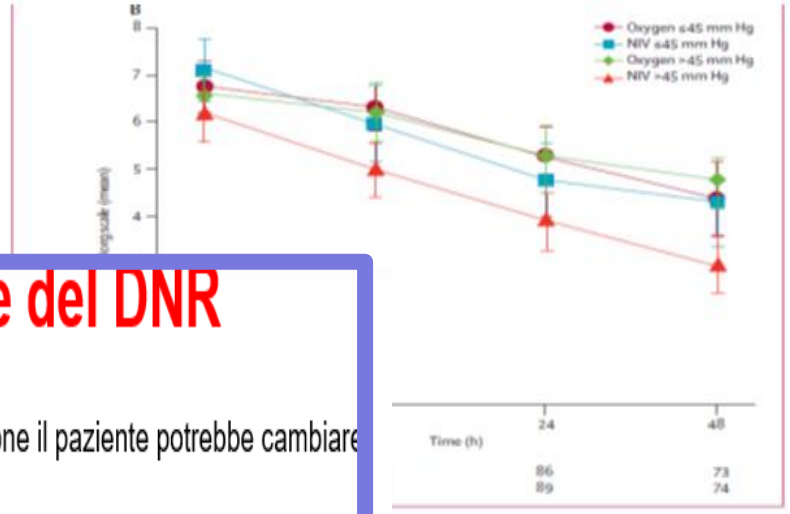
www.thelancet.com/oncology Vol 14 March 2013

Palliative use of non-invasive ventilation in end-of-life patients with solid tumours: a randomised feasibility trial

Stefano Nava, Miguel Ferrer, Antonio Esquinas, Raffaele Scala, Paolo Groff, Roberto Cosentini, Davide Guido, Ching-Hsiung Lin, Anna Maria Cuomo, Mario Grassi

Effetto sulla dispnea maggiore negli ipercapnici

Interpretation Our findings suggest that NIV is more effective compared with oxygen in reducing dyspnoea and decreasing the doses of morphine needed in patients with end-stage cancer. Further studies are needed to confirm our findings and to assess the effectiveness of NIV on other outcomes such as survival. The use of NIV is, however, restricted to centres with NIV equipment, our findings are not generalisable to all cancer or palliative care units.



and oxygen therapy assessed using the Borg scale over
within hypercapnia strata assessed using the Borg scale

key point della gestione del DNR

Gestione del rifiuto dell'intubazione : nei momenti di riacutizzazione il paziente potrebbe cambiare idea , va riformulata la proposta

Gestione della dispnea : l'eventuale discomfort e vantaggio rispetto agli oppioidi (?)

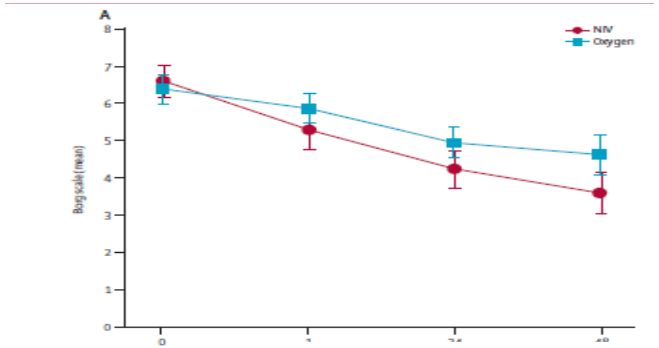


Figure 2: **Changes in dyspnoea scores with time**
(A) Comparison between non-invasive ventilation (NIV) and oxygen therapy assessed using the Borg scale over time. (B) Comparison between NIV and oxygen therapy within hypercapnia strata assessed using the Borg scale over time.

Punto cruciale dell'utilizzo della NIV come palliazione

The goal of treatment must be clear, and caution taken not to unnecessarily prolong suffering and death.

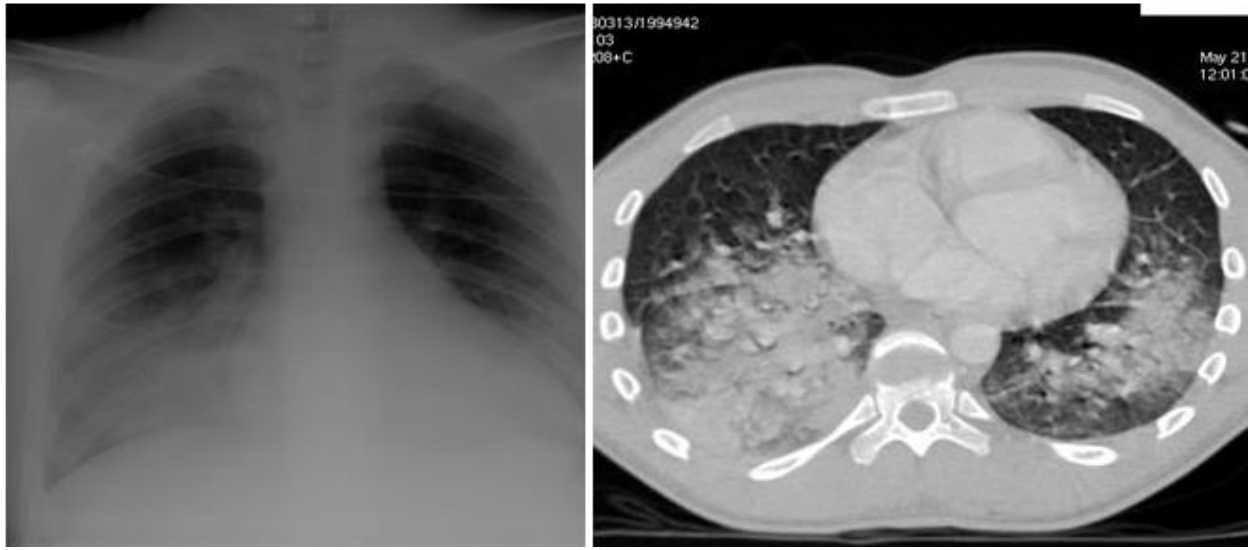
IR ipossiemica de novo

Definizione (PaO2/FIO2) <300, RR >30–35 apm senza malattia pneumologica nota

Cause : edema polmonare , polmoniti, infezioni

Mortalità:25-40%

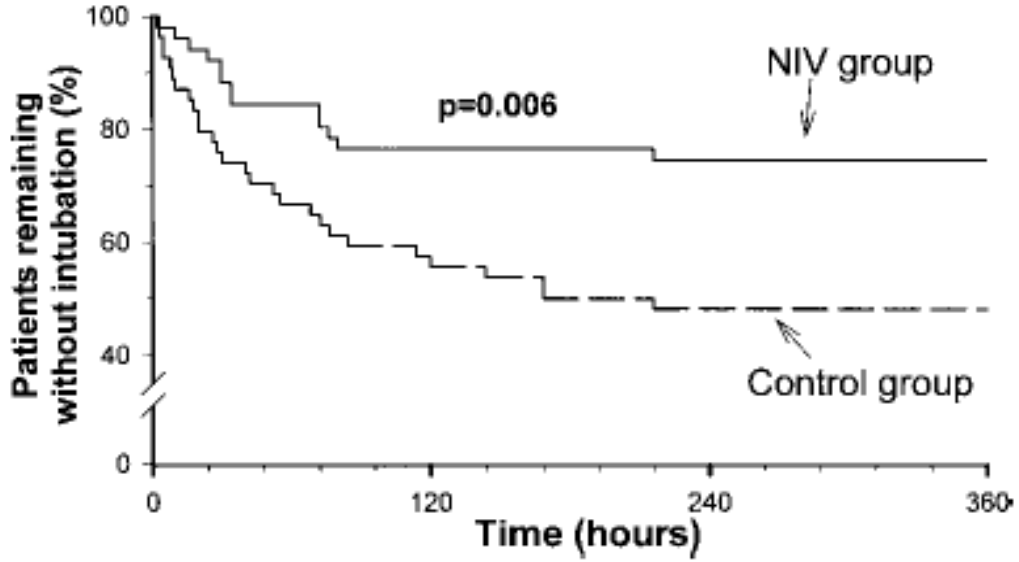
La NIV HA UN RUOLO?



Noninvasive Ventilation in Severe Hypoxemic Respiratory Failure

A Randomized Clinical Trial

Antoni Torres



AMERICAN JOURNAL OF RESPIRATORY AND CRITICAL CARE MEDICINE VOL 168 2003

Figure 2. Kaplan-Meier curves for patients remaining without intubation after entry into the protocol. In the overall population, the cumulative probability of remaining without intubation was higher in the noninvasive ventilation (NIV) group (log-rank test). Time denotes the hours after patients were entered into the study.

RESEARCH Open Access

He et al. Critical Care (2019) 23:300
https://doi.org/10.1186/s13054-019-2575-6

A multicenter RCT of noninvasive ventilation in pneumonia-induced early mild acute respiratory distress syndrome

Conclusions: Treatment with NIV did not reduce the need for intubation among patients with pneumonia-induced early mild ARDS, despite the improved PaO_2/FIO_2 observed with NIV compared with standard oxygen therapy. High minute ventilation may predict NIV failure.

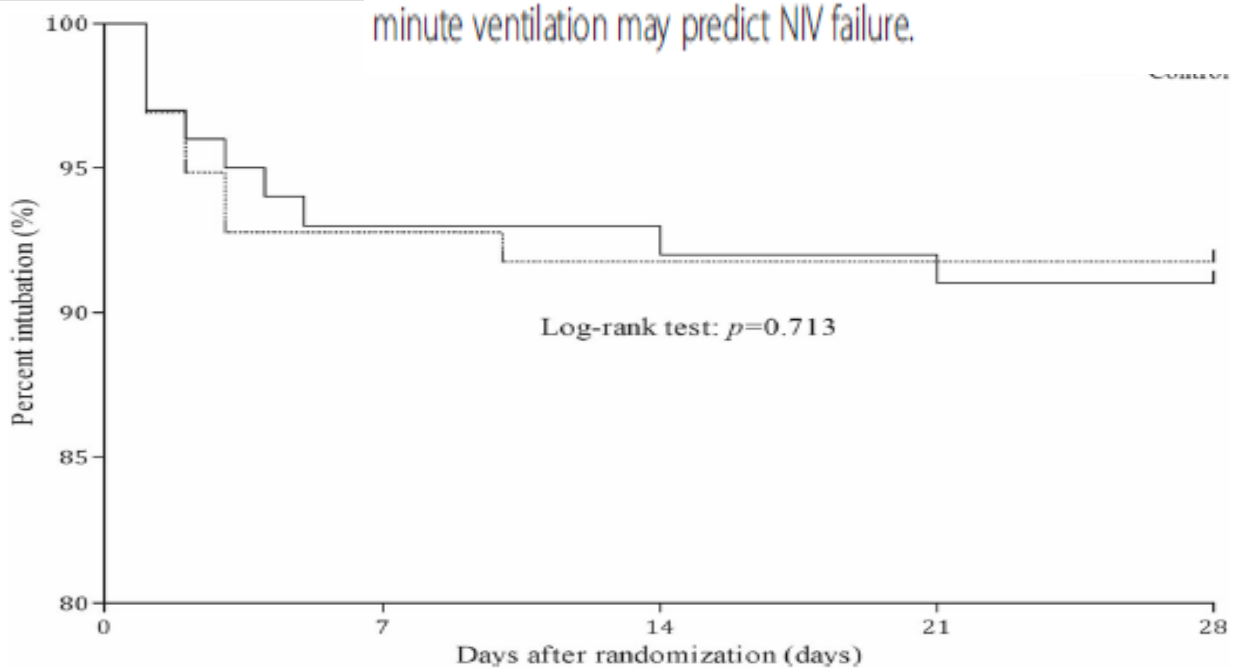


Fig. 2 Kaplan-Meier estimates of the probability of the need for endotracheal intubation based on the criteria for endotracheal intubation. No difference was found for the cumulative probability for endotracheal intubation of the two groups (log-rank test: $p = 0.71$)

INDIPENDENTEMENTE DAL MIGLIORAMENTO DELL'IPOSSIEMIA

La NIV nell'IRA ipossiemica : le considerazioni dei detrattori

Frequenza di intubazione:46-54%

Antonelli M,. Crit Care Med 2007;35:18-25.

Carrillo A. Intensive Care Med 2012;38:458-66.

Elevata mortalità

Probabili cause :

-Ritardo intubazione

Esteban A. N Engl J Med 2004;350:2452-60.

-Ventilator lung induced injury

Dreyfuss D. Am Rev Respir Dis 1993;148:1194-203.

Slutsky AS. N Engl J Med 2014; 370:980.

de Prost N, . Ann Intensive Care 2011;1:28.

Carteaux G et al ,. Crit Care Med 2016; 44: 282–290.

- La NIV è in grado di ridurre il lo sforzo inspiratorio solo se si utilizzano elevate pressioni che generano elevati tidal volume (superiori quindi ai valori di «ventilazione protettiva») e quindi aggravano il danno polmonare ,oltre a provocare distensione gastrica , perdite aeree e discomfort.
  Fra i predittori di fallimento (che si associa al self inflicted lung injury) vi è
  - Ventilazione minuto >11 L/min :
  - tidal volumes > 9 ml/ kg del peso corporeo **teorico** che si associa al self inflicted lung injury
  -FR: più è alta maggiore sarà la ventilazione / min (VtxRR)

He , Critical care 2019

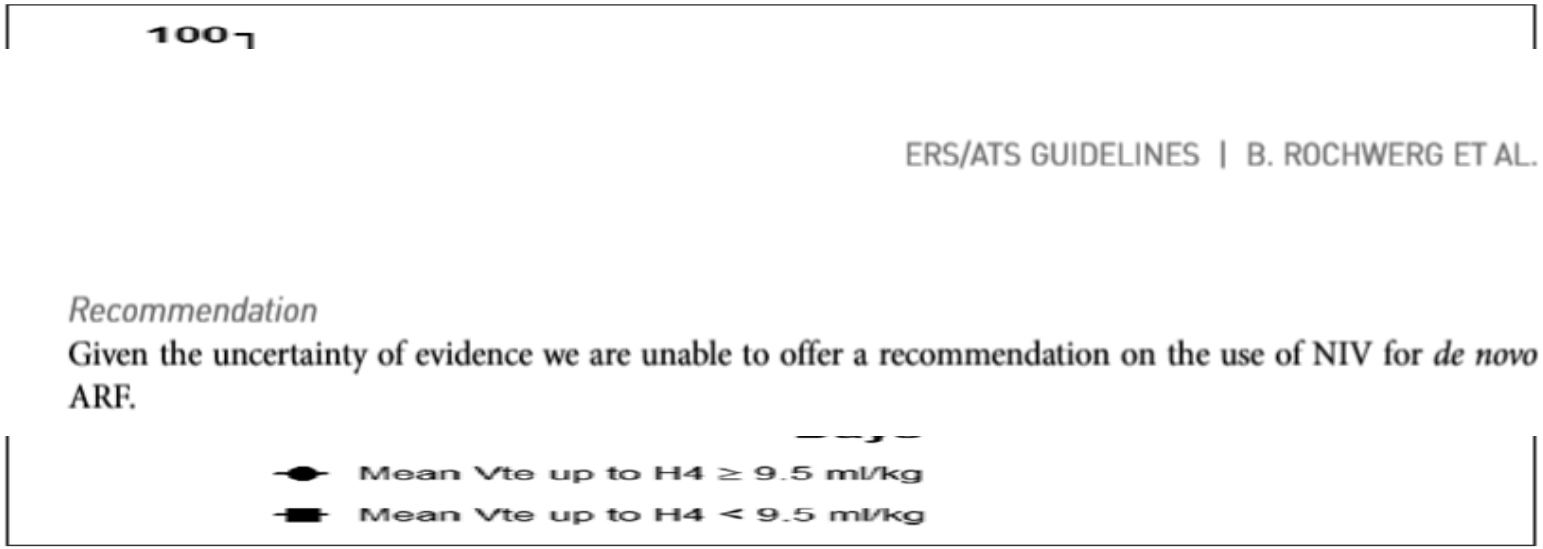
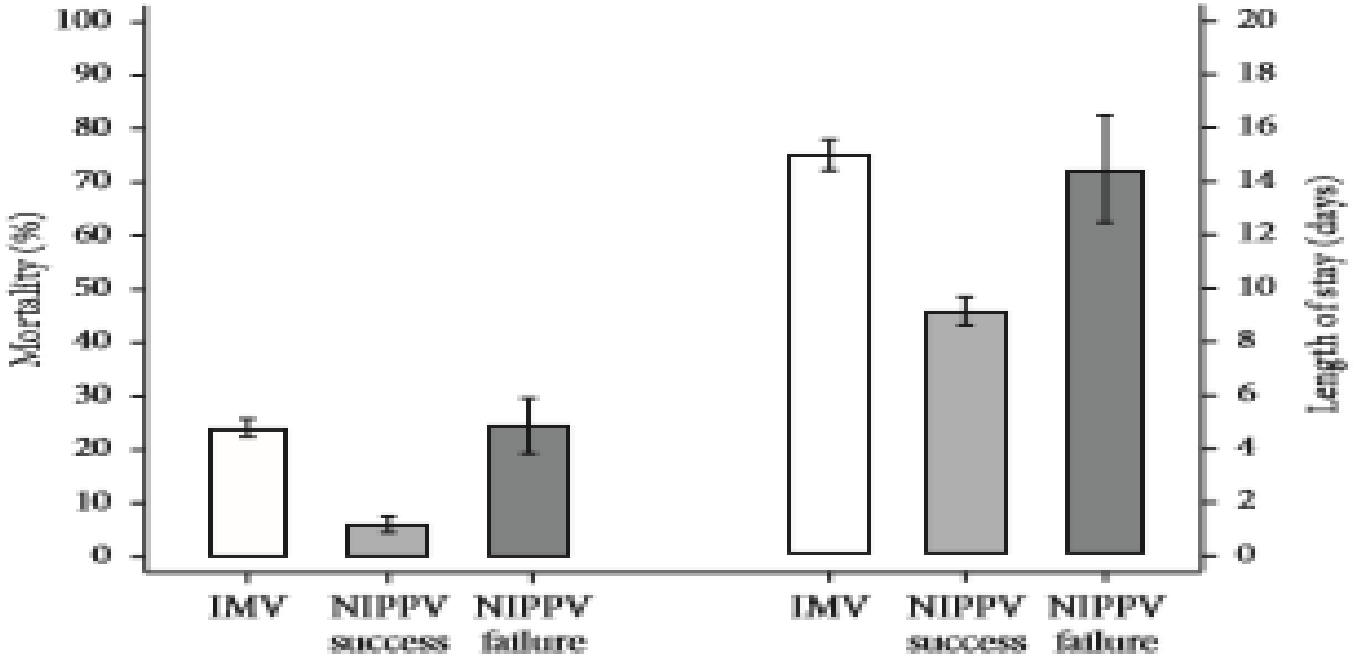


Figure 4. Kaplan-Meier estimate of the cumulative probability of noninvasive ventilation (NIV) failure according to the mean tidal volume (Vte) during the first four cumulative hours of NIV (higher or lower than 9.5 mL/kg) in patients with moderate-to-severe hypoxemia (Pa_{O_2}/Fi_{O_2} ratio ≤ 200 mm Hg; $n = 33$).

Carteaux G et al ,. Crit Care Med 2016; 44: 282–290.

Outcomes of Noninvasive Positive Pressure Ventilation in Acute Respiratory Distress Syndrome and Their Predictors: A

C



Critical Care Research and Practice
Volume 2019, Article ID 8106145, 8 pages

Se si fa …. FACCIAMOLO BENE!

Basso PS , PEEP la maggiore tollerata (almeno 8)

Helmet, sfruttando gli elevati flussi per la distensione (100-200 l/sec)

Yoshida T.. Am J Respir Crit Care Med 2017;195:985–992.,Mauri T.. Crit Care Med 2013;41:1664–73.,Morais CCA. Am J Respir Crit Care Med 2018;197:1285–1296). Taccone P, Crit Care Med. 2004; 32(10):2090–2096 ,Patel BK. JAMA. 2016;315(22):2435–41.

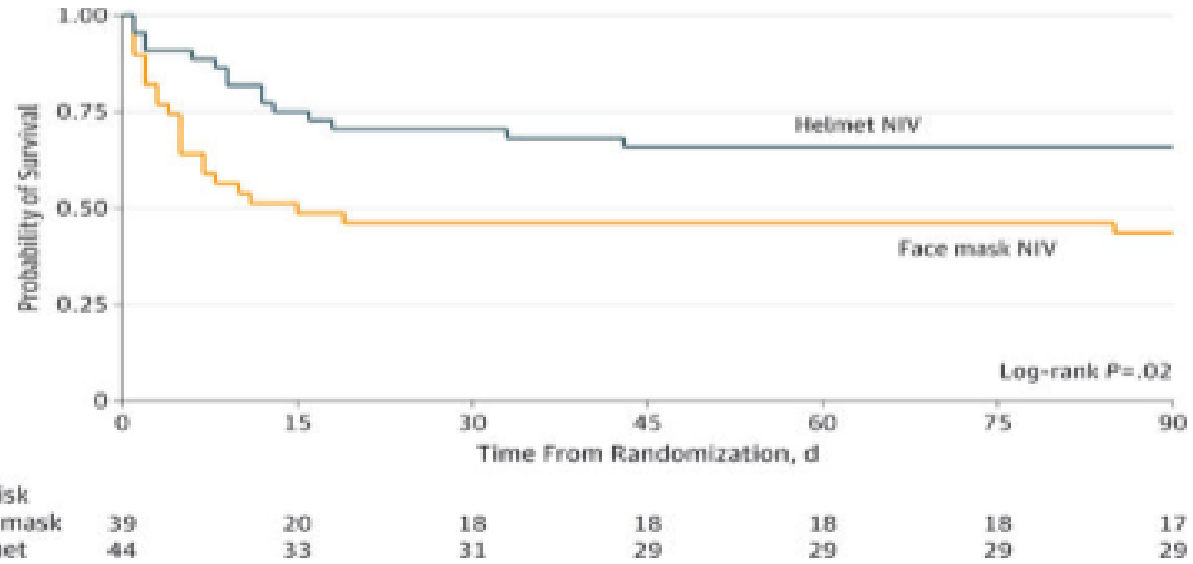


Figure 2. Probability of Survival From Randomization to Day 90
NIV indicates noninvasive ventilation.

Attenzione alle false aspettative!!!!

il beneficio della ventilazione a bassa VT è più significativo nei casi di ARDS lieve

Shen Y,. Crit Care. 2019;23(1):254

Minore è il rapporto PaO2/ FiO2 maggiore è la possibilità di fallimento (soprattutto se < a 150)

Bellani G, LUNG SAFE Study. Am J Respir Crit Care Med. 2017;195(1):67–77.

Cortegiani *et al. Critical Care* (2018) 22:157
https://doi.org/10.1186/s13054-018-2079-9

Critical Care

RESEARCH Open Access

Immunocompromised patients with acute respiratory distress syndrome: secondary analysis of the LUNG SAFE database

Table 3 Clinical endpoints in immunocompromised (Study) patients according to ventilation subgroup

Clinical endpoints	IMV (n = 462)	NIV (n = 63)	NIV failure (n = 59)	p Value
Duration of mechanical ventilation, d, median (Q_1–Q_3)	8.0 (4.0–14.0)	–	8.0 (5.0–15.0)	0.4352
Progression/regression of ARDS[a], n (%)				
No change	161 (40.1)	18 (32.1)	22 (43.1)	0.4449
Progression	43 (10.7)	5 (8.9)	7 (13.7)	0.7199
Regression	103 (25.7)	4 (7.1)[b]	16 (31.4)[c]	**0.0045**
Resolution	94 (23.44)	29 (51.8)[b]	6 (11.8)[c]	**< 0.0001**
Limitation of life-sustaining measures, n (%)				
Decision to withhold life-sustaining measures	124 (26.8)	18 (28.6)	16 (27.1)	0.9587
Decision to withdraw life-sustaining measures	101 (21.9)	14 (22.2)	14 (23.7)	0.9480
Decision to withhold or withdraw life-sustaining measures	154 (33.3)	21 (33.3)	20 (33.9)	0.9962
Before IMV or NIV start	1 (0.6)	0 (0.0)	1 (5.0)	0.2062
ICU mortality[d], n (%)	214 (46.3)	18 (28.6)[b]	34 (57.6)[c]	**0.0043**
Hospital mortality[e], n (%)				
All patients	242 (52.8)	25 (39.7)	37 (62.7)[c]	**0.0362**
Patients with limitations of life-sustaining measures[f]	137 (89.0)	17 (81.0)	19 (95.0)	0.3803

Official ERS/ATS clinical practice guidelines: noninvasive ventilation for acute respiratory failure

Bram Rochwerg[1], Laurent Brochard[2,3], Mark W. Elliott[4], Dean Hess[5], Nicholas S. Hill[6], Stefano Nava[7] and Paolo Navalesi[8] (members of the steering committee); Massimo Antonelli[9], Jan Brozek[1], Giorgio Conti[9], Miquel Ferrer[10], Kalpalatha Guntupalli[11], Samir Jaber[12], Sean Keenan[13,14], Jordi Mancebo[15], Sangeeta Mehta[16] and Suhail Raoof[17,18] (members of the task force)

Recommendation

We suggest early NIV for immunocompromised patients with ARF. (Conditional recommendation, moderate certainty of evidence.)

Negli anziani immunodepressi la NIV …

rispetto alla ventilazione invasiva riduce la mortalità a 90 gg, mentre a 30 gg la mortalità è dovuta alla polmonite di per se

Johnson CS. BMC Pulm Med 2014; 14: 7.

Il 50% dei pz riesce ad evitare l'intubazione

I grossi limiti sono le comorbidità severe e le riammissioni

Segrelles Calvo G. Arch Bronconeumol 2012; 48: 349–354.

Esquinas Rodríguez AM Arch Bronconeumol 2013; 49: 275–276

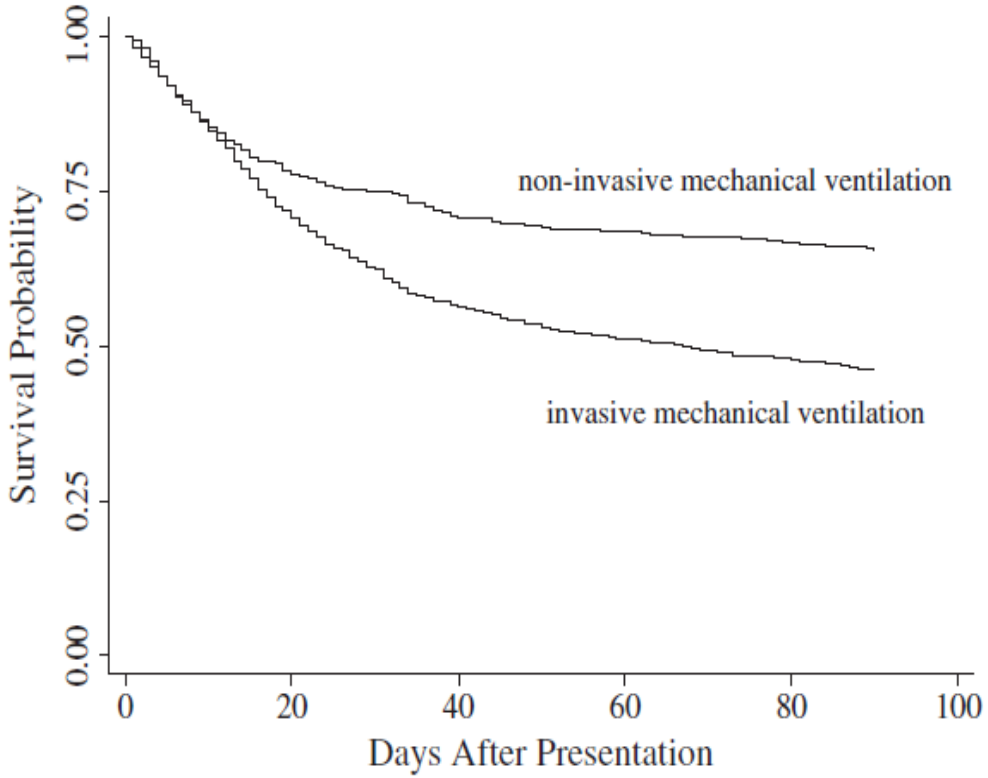


Figure 1 Kaplan-Meier plot of 90-day survival. Patients undergoing non-invasive mechanical ventilation had significantly higher survival than did invasive ventilation patients ($p < 0.001$ by the log-rank test).

Johnson *et al. BMC Pulmonary Medicine* 2014, **14**:7
http://www.biomedcentral.com/1471-2466/14/7

Il mondo ideale : NIV SI in particolare se Pao2/FiO2è fra 200 e 300 …

Se c'è compromissione solo respiratoria

Se non c'è sepsi/shock settico (MAGARI)

Se il team è esperto (AUSPICABILE)

Se il paziente è monitorato per essere intubato prontamente , idealmente in UTI (o in accordo con l'UTI)

Se il paziente è immunodepresso

Se il paziente è anziano

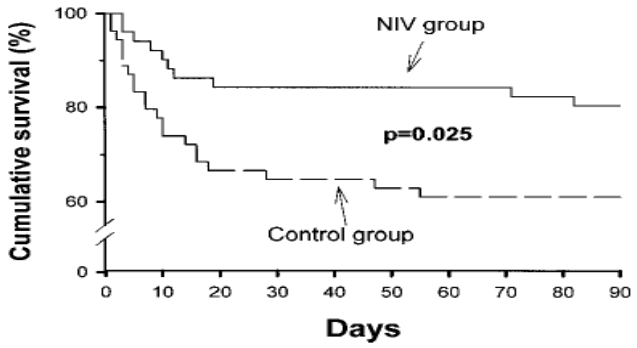


Figure 4. Kaplan-Meier curves for survivor patients within 90 days after entry into the protocol. In the overall population, the cumulative survival probability was significantly higher in the NIV group (log-rank test). *Time* denotes the days after patients were entered into the study.

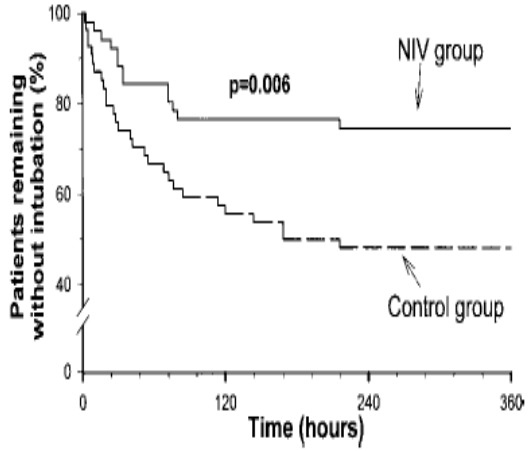


Figure 2. Kaplan-Meier curves for patients remaining without intubation after entry into the protocol. In the overall population, the cumulative probability of remaining without intubation was higher in the noninvasive ventilation (NIV) group (log-rank test). Time denotes the hours after patients were entered into the study.

Ferrer M, Esquinas A, Leon M, et al. Noninvasive ventilation in severe hypoxemic respiratory failure: a randomized clinical trial. Am J Respir Crit Care Med 2003; 168: 1438–1444

Dove lo ventilo ?

In base al pH

In base alla probabile risposta alla NIV

In base alla disponibilità di monitoraggio

In base alla disponibilità di personale esperto

In base al numero di organi compromessi

in base alla necessità di sedazione

UTI, SUB, reparto?

Anche se negli anni sempre più pazienti vengono trattati fuori dall'UTI…

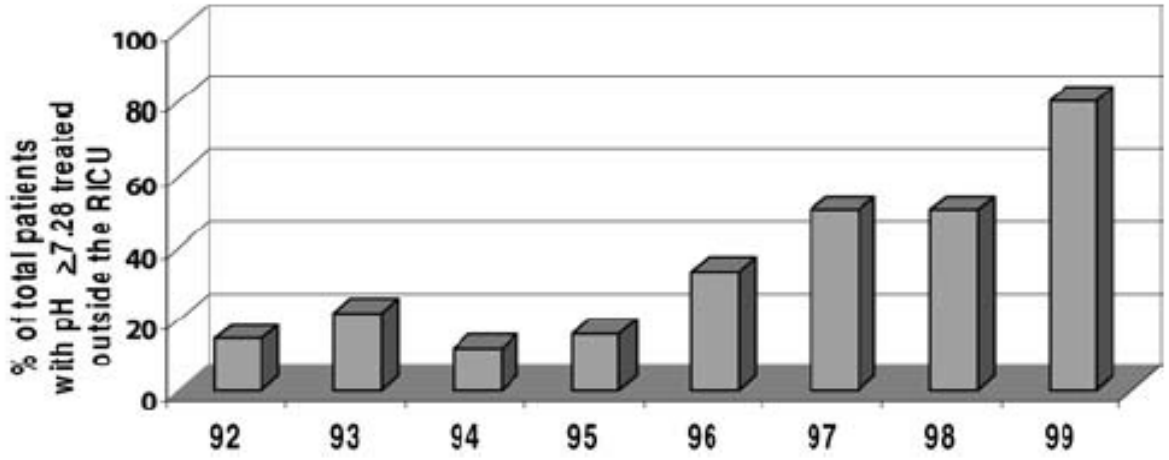


Fig. 4 Percentage of patients with pH >7.28 treated outside the RICU, in the medical ward, in the 8 years of the study. $P<0.001$ in the x^2 Hf for linear trend analysis

Well trained staff are key to the success of NIV…….

Carlucci A, Delmastro M, Rubini F, Fracchia C, Nava S. Changes in the practice of non-invasive ventilation in treating COPD patients over 8 years. Intensive Care Med 2003; 29: 419–25.

Ci sono situazioni associate ad alta probabilità di fallimento

pH< a 7.25 di base e ad 1 h dalla NIV

Insufficienza respiratoria severamente ipossiemica (PaO2/FiO2< 200)

Coinvolgimento di più organi, sepsi e instabilità emodinamica

RR>35 apm pre NIV e dopo 2 ore dalla NIV nei BPCO

RR>25 durante NIV nelle forme ipossiemiche post-operatorie e nei pazienti ematologici

Nell'edema polmonare :IMA, un pH< a 7.25, una FE < a 30%, una PA< a 140 mmHg sono fattori predittori di intubazione ; un pH di 7.03 è il cut-off predittivo di successo della NIV.

Nava S, Hill N. Non-invasive ventilation in acute respiratory failure. Lancet.2009;374:250–9.

Ozyilmaz E, Ugurlu AO, Nava S. Timing of non-invasive ventilation failure: causes, risk factors, and potential remedies. BMC Pulm Med. 2014;14:19.

Scala R, et. Co-morbidity and acute decompensations of COPD requiring non-invasive positive-pressure ventilation. Intensive Care Med. 2004;30:1747–54.

Shirakabe A, et al : Predicting the success of noninvasive positive pressure ventilation in emergency room for patients with acute heart failure. J Cardiol 2010, 57:107–114.

Meglio in UTI

Eur Respir J 2005; 25: 348–355
DOI: 10.1183/09031936.05.00085304
Copyright©ERS Journals Ltd 2005

A chart of failure risk for noninvasive ventilation in patients with COPD exacerbation

M. Confalonieri*, G. Garuti[#], M.S. Cattaruzza[¶], J.F. Osborn[¶], M. Antonelli[+], G. Conti[+], M. Kodric*, O. Resta[§], S. Marchese[ƒ], C. Gregoretti and A. Rossi, on behalf of the Italian noninvasive positive pressure ventilation (NPPV) study group[##]**

Patients with a Glasgow Coma Score <11, acute physiology and chronic health evaluation (APACHE) II ⩾29, respiratory rate ⩾30 breaths·min^{-1} and pH at admission <7.25 have a predicted risk of failure >70%. A pH <7.25 after 2 h greatly increases the risk (>90%). The risk charts were

Intensive Care Med (2002) 28:1701–1707
DOI 10.1007/s00134-002-1478-0

Non abbiate paura dell'intubazione!!!!

G. Conti
M. Antonelli
P. Navalesi
M. Rocco
M. Bufi
G. Spadetta
G. U. Meduri

Noninvasive vs. conventional mechanical ventilation in patients with chronic obstructive pulmonary disease after failure of medical treatment in the ward: a randomized trial

- Pazienti GRAVI: pH < 7.20 o frequenza respiratoria ≥ 35/min.
- Non differenza significativa di mortalità tra ventilazione non-invasiva (26%) ed intubazione (19%)
- Non differenza di durata della degenza in Terapia Intensiva (22 vs. 21 giorni in media
- elevata frequenza di fallimento della ventilazione non-invasiva (il 52% viene intubato)
- l'elevata mortalità nei pazienti con fallimento della ventilazione non-invasiva (42%).

TRADOTTO

Nei pazienti con grave riacutizzazione di BPCO e necessità di supporto ventilatorio, la ventilazione non-invasiva non offre vantaggi clinici rispetto all'intubazione, fallisce una volta su due e quando fallisce la mortalità è molto elevata. Visti da un altro punto di vista, gli stessi numeri ci dicono però che circa la metà di questi pazienti evita efficacemente l'intubazione tracheale.

dove gestire il paziente in base al pH di partenza?

se pH < 7.25 meglio in ambiente protetto

Brochard L,. N Engl J Med 1995, 333:817–822.

Martin TJ,. Am J Respir Crit Care Med 2000, 161:807–813

se pH>7.3 e lo staff è formato anche in reparto

Plant PK. Lancet 355(9219):1931–193

Dove ventilo in base alla patologia

-edema polmonare acuto: anche in ambulanza

Roessler MS,. Emerg Med J 2012;29:409–14.

Templier F,. Am J Emerg Med 2012;30:765–9.

- in caso di dnr : fuori dall'UTI

1)Se palliativa anche nei reparti dove la presenza dei familiari migliora il comfort delle ore di fine vita e a volte la mortalità è minore dell'atteso (es la NIV applicata in reparto di geriatria con staff esperto ha una mortalità del 25%)

Vargas N. Aging Clin Exp Res 2014; 26: 615–623

2) Se è un do not intubate ma NON un do not care : subintensiva dove possono essere erogate cure INTENSIVE MA NON INVASIVE

E il paziente anziano?

Ricovero in rianimazione e ventilazione meccanica non sono di per se associate a cattiva prognosi negli anziani senza preesistenti malattie respiratorie

Wood KA, Ely W. What does it mean to be critically ill and elderly? Current Opinion in Critical Care 2003; 9: 316–20

Esteban A, Anzueto A, Frutos-Vivar Fet al. Outcome of older patients receiving mechanical ventilation. Intensive Care Med

2004; 30: 639–646.

Nonostante ciò….

Maité Garrouste-Orgeas
Jean-François Timsit
Luc Montuclard
Alain Colvez
Olivier Gattolliat
François Philippart
Guillaume Rigal
Benoit Misset
Jean Carlet

Decision-making process, outcome, and 1-year quality of life of octogenarians referred for intensive care unit admission

Intensive Care Med (2006) 32:1045–1051

Nel 50% dei casi l'età guida la scelta di NON trasferire il pz in UTI anche quando ve ne sia l'indicazione

Table 2 Logistic regression analysis to identify factors independently associated with refusal of ICU admission (*CI* confidence interval)

	Odds ratio for refusal	95% CI	*p*
Medical patient	5.96	1.26–28.2	0.02
Examination by an ICU physician	5.75	1.21–27.2	0.02
Full unit	4.72	1.37–16.2	0.01
Age > 85 years	4.16	1.44–12.0	0.008
No help needed for toileting	0.04	0.21	< 0.0001

Age and Ageing 2009; **38:** 515–520
doi: 10.1093/ageing/afp119
Published electronically 15 July 2009

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Age, invasive ventilatory support and outcomes in elderly patients admitted to intensive care

Results: age was strongly correlated with mortality among the invasively ventilated subgroup of patients and the multivariate adjusted odds ratios increased progressively with every age increment (OR = 1.60, 95% CI = 1.01–2.54 for 65–74 years old and OR = 2.68, 95% CI = 1.58–4.56 for ≥75 years). For the patients not submitted to invasive ventilatory support, age was not independently associated with in-hospital mortality (OR = 2.28, 95% CI = 0.99–5.25 for 65–74 years old and OR = 1.95, 95% CI = 0.82–4.62 for ≥75 years old).

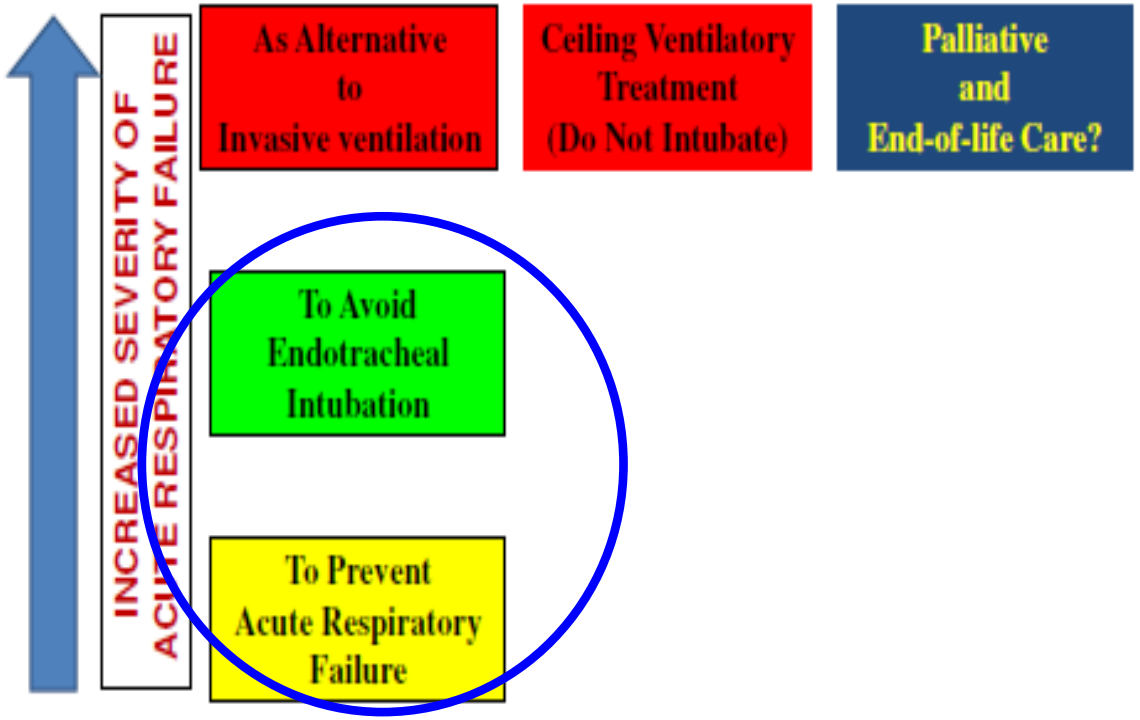
Conclusions: the combination of age and invasive mechanical ventilation is strongly associated with in-hospital mortality. Age should not be considered as a factor related to in-hospital mortality of elderly patients not requiring invasive ventilatory support in ICU.

Fattori condizionanti la mortalità : age, invasive mechanical ventilation, organ dysfunction, severity of impairment on admission, primary cause for admission and time between hospital and ICU admission

Table 2. Variables independently predictive of in-hospital mortality by logistic regression

Variable	Odds ratio (95% CI)	*P*-value
Age (65–74 years)	1.68 (1.11–2.53)	0.013
Age (75–84 years)	2.44 (1.56–3.80)	< 0.001
Medical admission	3.30 (2.17–5.00)	< 0.001
Unscheduled surgery	2.08 (1.27–3.39)	0.003
APS, points	1.05 (1.03–1.07)	< 0.001
Invasive ventilatory support	6.12 (4.04–9.29)	< 0.001
Time hospital/ICU (days)	1.03 (1.01–1.05)	0.011

Proprio per questo …….



Reasons for applying non-invasive ventilation in elderly at different stages of acute respiratory failure

Scala *BMC Pulmonary Medicine* (2016) 16:150

Per fortuna anche negli anziani….

Age and Ageing 2011; **40:** 444–450

Non-invasive ventilation in elderly patients with acute hypercapnic respiratory failure: a randomised controlled trial

Stefano Nava[1], Mario Grassi[3], Francesco Fanfulla[2], Guido Domenighetti[4], Annalisa Carlucci[2], Andreas Perren[5], Daniela Dell'Orso[6], Michele Vitacca[7], Piero Ceriana[2], Zuhal Karakurt[8], Enrico Clini[6]

Conclusions: compared with SMT, NIV decreased the rate of meeting the ETI criteria and the mortality rate of very old patients with AHRF. NIV should be offered as an alternative to patients considered poor candidates for intubation and those with a DNI order.

the importance of using NIV not only as a palliative measure but, also, as a preferential treatment when intubation is either not wanted by the patient or questionable for the physician.

Le condizioni che limitano le possibilità di successo rimangono sempre gli stessi

Table 1 Likelihood of success of NIV in elderly patients according to the different types of ARF

Clinical condition with Acute Respiratory Failure	Avoidance of intubation Reduction of Mortality
COPD exacerbations	+++
Cardiogenic pulmonary edema	+++
Immuno-compromised status	+++
Obesity-hypoventilation	+++
Chest wall deformities	+++
Weaning/Extubation in COPD	++–
Mild-moderate Encephalopathy	++–
Neuromuscular diseases[a]	++–
Community Acquired Pneumonia	+––
Mild ARDS	+––
Agitation/Delirium[b]	+––
Interstitial fibrotic lung diseases	–
Multi-organ failure/Comorbidities	–

[a] with cough augmentation techniques
[b] with low doses of sedatives

Scala *BMC Pulmonary Medicine* (2016) 16:150

Tenendo presente che ….

	ICU	RICU	WARD	ED
Staff number				
Lenght of stay				
Monitoring/equipment				
Expertise with NIV				
Familiarity with EOL decision				
Prompt availability of ETI				
Costs				
Link with home-care				

Fig. 2 Characteristics of the different settings where non-invasive ventilation (NIV) may be applied. Green, yellow, red indicates respectively a highly favorable, favorable, unfavorable issue for the different enviro-ment. ICU: Intensive Care Unit, RICU: Respiratory Intensive Care Unit, ED: Emergency Department, ETI: endotracheal intubation, EOL: end-of-life

Scala *BMC Pulmonary Medicine* (2016) 16:150

il vecchietto dove lo metto?

NONINVASIVE VENTILATION IN OLDER ADULTS ADMITTED TO A PNEUMOGERIATRIC UNIT

To the Editor: This study involved 30 individuals aged 80 and older (range 81–101) who underwent noninvasive ventilation (NIV) in the Pneumogeriatric Unit, Department of Geriatrics, Campus Bio-Medico University, Rome, Italy between April 1, 2012, and September 30, 2013. This unit

The presence of delirium or dementia was not a barrier for the indication or for the administration of NIV; the presence of a pneumogeriatric team allowed the symptoms to be controlled and the cooperation of the subjects to be obtained. In addition, NIV in a non-ICU setting allows relatives to visit more frequently and for longer time.[4] Moreover, the presence of a pneumogeriatric team could promote hospital discharge, education of caregivers, and selection of the best discharge setting.

In conclusion, NIV is effective and safe also in very old adults; this setting and this model of care qualify as a valuable alternative to costly, busy intensive or subintensive units.

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Table 1. Main Diagnostic and Therapeutic Procedures Scheduled in the Pneumogeriatric Therapeutic Plan for Very Old Patients Undergoing Noninvasive Ventilation

Definition of the therapeutic target, based on current and historical health status.
Nutritional assessment and support.
Monitoring of fluids, electrolytes, and acid–base balance.
Execution of echocardiography, chest X ray, and dosage of N-terminal pro-brain natriuretic peptide for screening and prognostic purposes.
Drug dose adjustment according to renal and hepatic function.
Reduction of polypharmacy by discontinuing unnecessary or inappropriate medications.
Prevention of pressure ulcers using a validated protocol.
Prevention and treatment of constipation.
Prevention and treatment of delirium and dementia using pharmacological and nonpharmacological therapies.
Early start of physical and respiratory rehabilitation.
Early removal of urinary catheter and voiding rehabilitation, as needed.
Negotiate with caregivers and social workers the destination and health and social care needs at discharge.
Design and implementation of a training program for caregivers.
Performing a comprehensive geriatric assessment at discharge and planning an integrated pneumogeriatric ambulatory follow-up.

Beyond the guidelines for non-invasive ventilation in acute respiratory failure: implications for practice

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Key messages

- Guidelines for the use of non-invasive ventilation (NIV) in acute or chronic hypercapnic respiratory failure and acute hypoxaemic respiratory failure are evidence based and should be followed
- The right patient
  - The cause of respiratory failure is important in determining the likelihood of a successful outcome with NIV
  - NIV should not be used when it is very unlikely to succeed or when a purely palliative approach would be more appropriate—prediction tools should inform decision making
- The right time
  - Physiological criteria should be used to determine the timing of NIV
  - NIV should be discontinued in a timely manner if the patient is deteriorating on the basis of worsening pH and respiratory rate (for acute hypercapnic respiratory failure) or exhaled tidal volume >9·5 mL/kg and heart rate, acidosis, consciousness, oxygenation, respiratory rate score >5 after 1 h (for hypoxaemic respiratory failure)
- The right equipment
  - The correct interface should be used and should fit well
  - Condition-specific settings should be used, and adjusted according to response
- The right environment
  - The unit or ward should be properly staffed and resourced
  - Staff should be NIV trained and competency assessed
  - Training should be updated regularly
- Ongoing audits and quality assurance should be done

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Sappiate quando iniziare (o far iniziare) e quando fermarvi!

Durante il trattamento…

Garantire la sicurezza del malato

Effettuare la valutazione prognostica per rivalutare il giusto setting e anticipatamente decidere su eventuale DNR

Mettere in atto le strategie per evitare il fallimento della NIV (prevenzione delle lesioni da decubito dell'interfaccia e del delirium, gestione delle secrezioni e della frequenza delle evacuazioni, attenzione all'aspetto nutrizionale)

Identificare precocemente il fallimento per l'upgrade di invasività delle cure quando indicato

GRAZIE