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63 CONGRESSO NAZIONALE SIGG
GLI ANZIANI: LE RADICI DA PRESERVARE
ROMA 28 novembre – 01 dicembre 2018

La NIV nel malato ristretto

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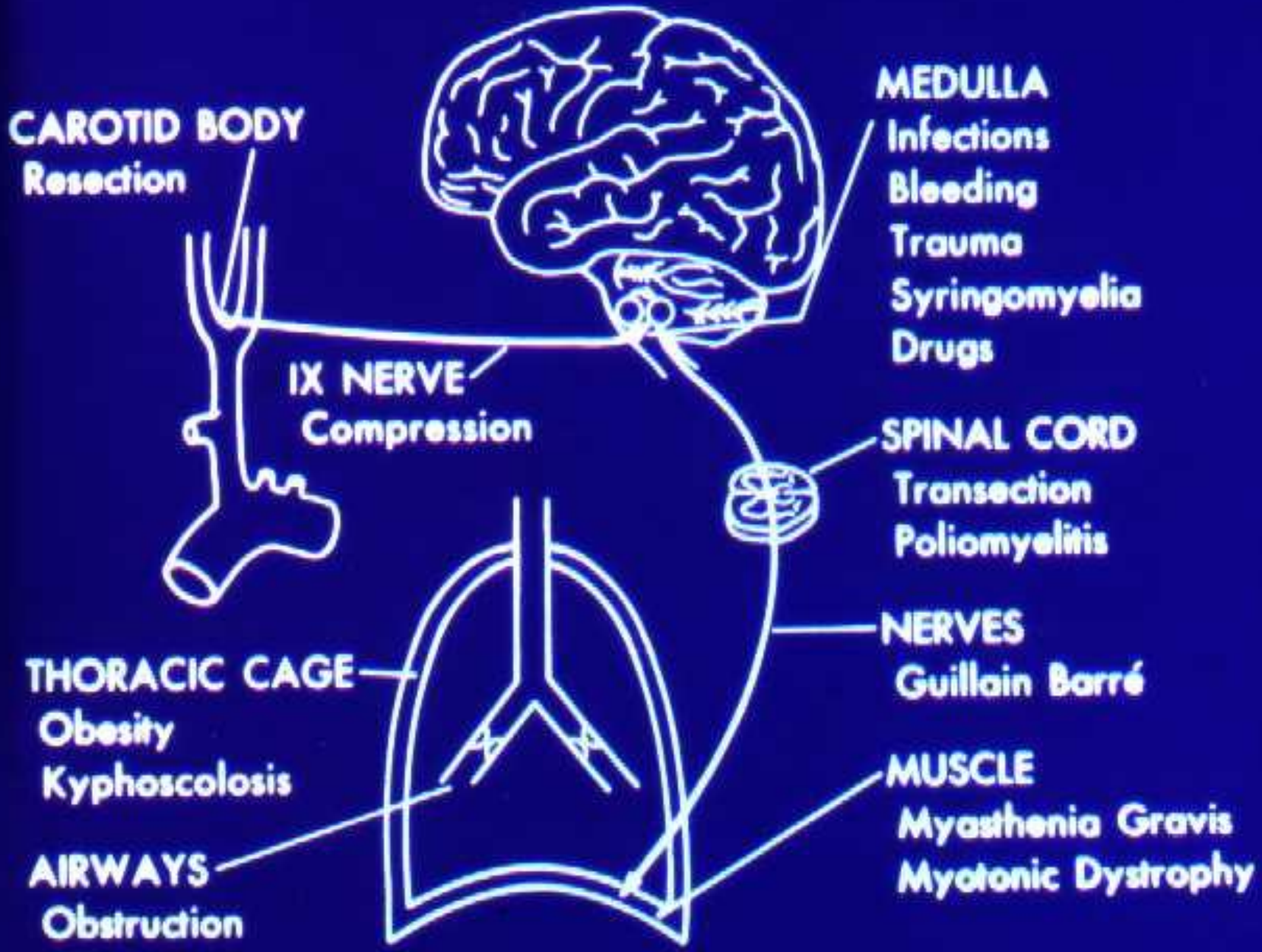
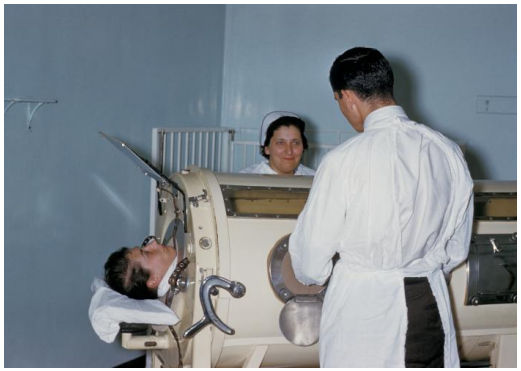
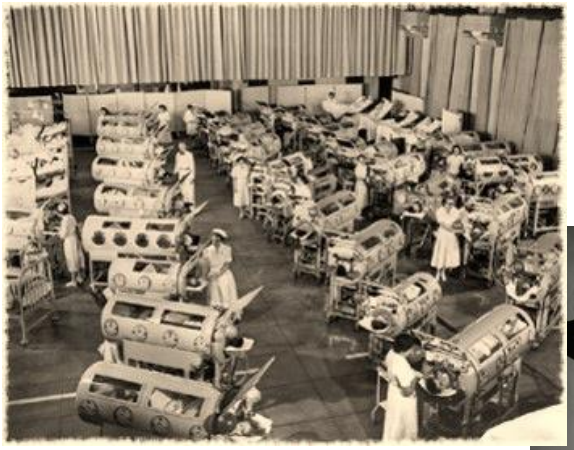
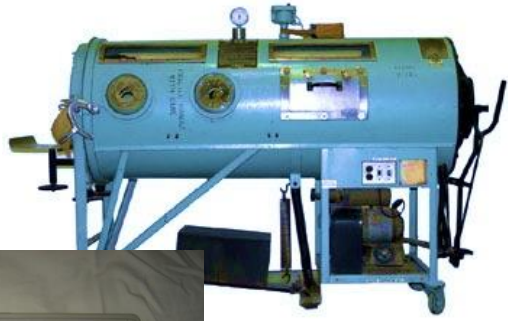
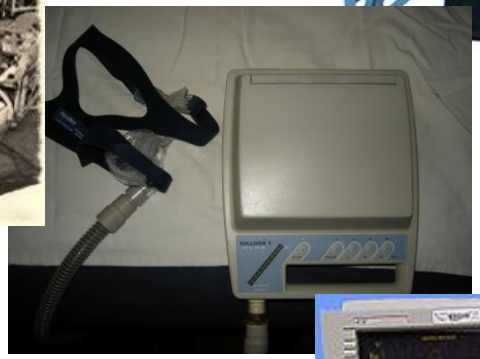
Roma 28.11.2018

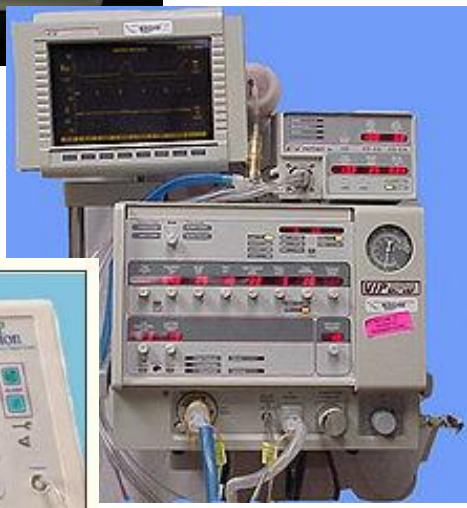

CAROTID BODY
Resection
MEDULLA
Infections
Bleeding
Trauma
Syringomyelia
Drugs
IX NERVE
Compression
SPINAL CORD
Transection
Poliomyelitis
NERVES
Guillain Barré
THORACIC CAGE
Obesity
Kyphoscolosis
MUSCLE
Myasthenia Gravis
Myotonic Dystrophy
AIRWAYS
Obstruction

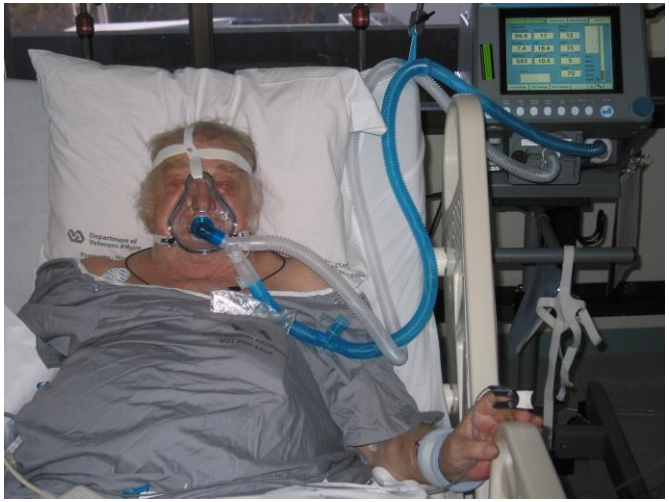


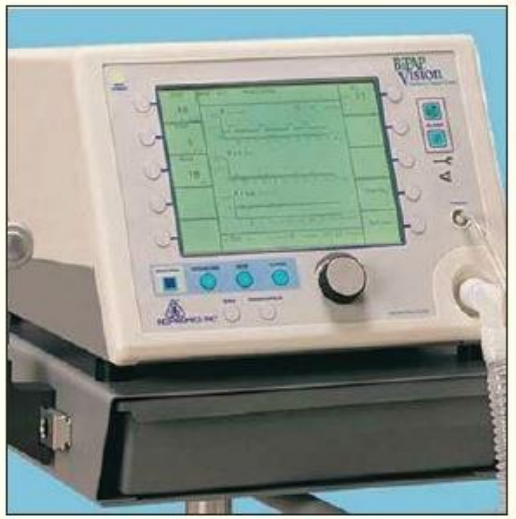












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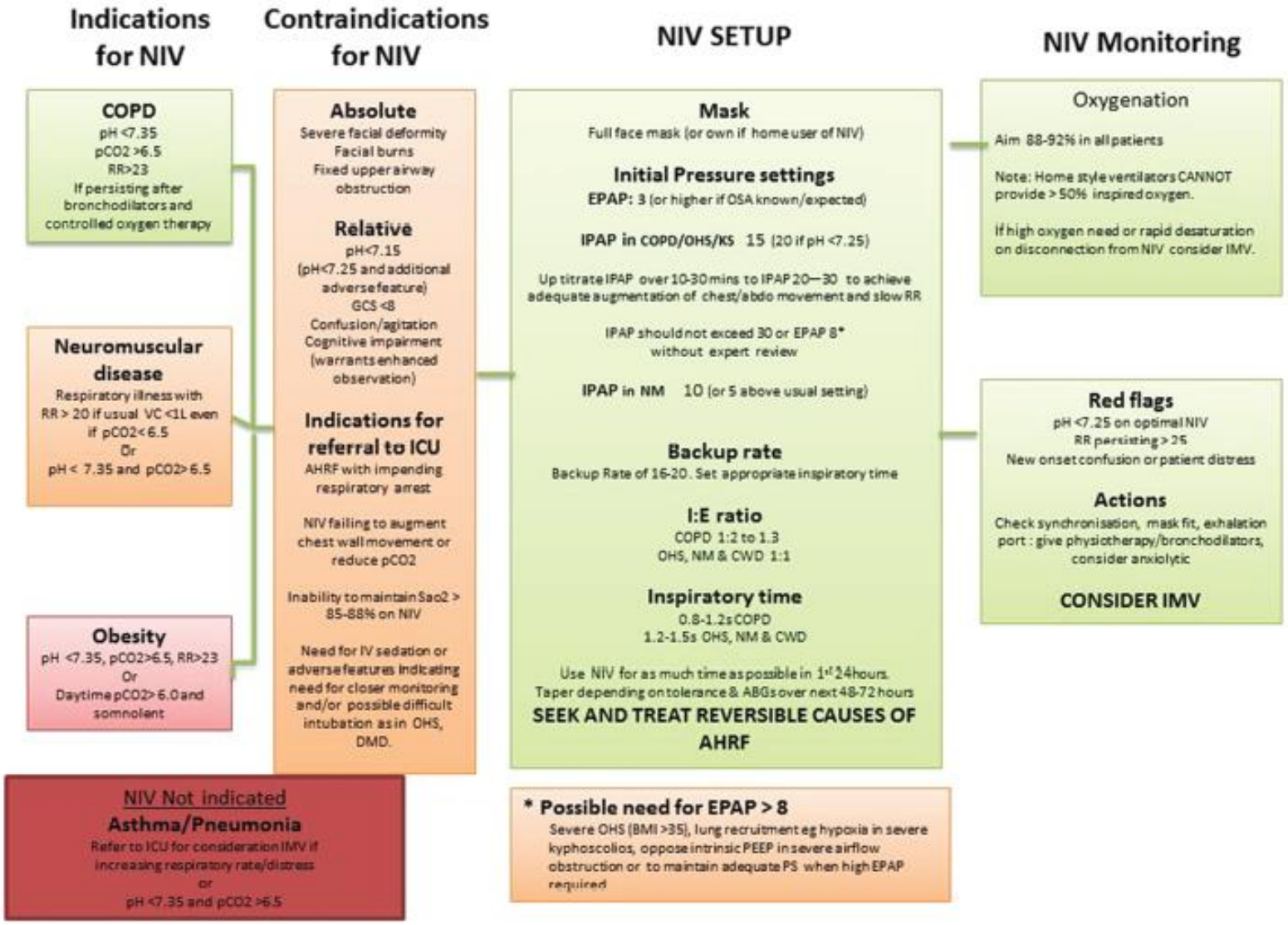


Figure 1 Summary for providing acute non-invasive ventilation.

Livello 1

Favorevole	Sfavorevole
Esacerbazione BPCO	
Svezzamento BPCO	
Edema polmonare acuto	
Paziente immunocompr	
Prevenzione insuff respiratoria post ext in pazienti a rischio	

Livello 2

Favorevole	Sfavorevole
DNI	CAP severa
Palliazione dispnea	Trattam ins resp post ext
CAP nel BPCO	ARDS severo
Insuff resp. Post chir	
Prevenzione insuff resp	
Asma	

Livello 3

Favorevole	Sfavorevole
Patologia neuromuscolare	SARS e pandemie
Trauma toracico	
Tratt pat restritt toraciche	
Insuff resp.	
Tratt insuff resp asma	

Livello 4

Favorevole	Sfavorevole
Età molto avanzata	Fibrosi polmonare idiopatica
Fibrosi cistica	
Palliazione dispnea	
OHS	

Timing di applicazione della NIV

pH<7,35>7,30 o PaO2/FiO2<300>250

⬇

Prevenire la progressione IRA

pH<7,30>7,25 o PaO2/FiO2<250>200

⬇

Evitare l'intubazione

pH<7,250 o PaO2/FiO2<200

⬇

Alternativa all'intubazione

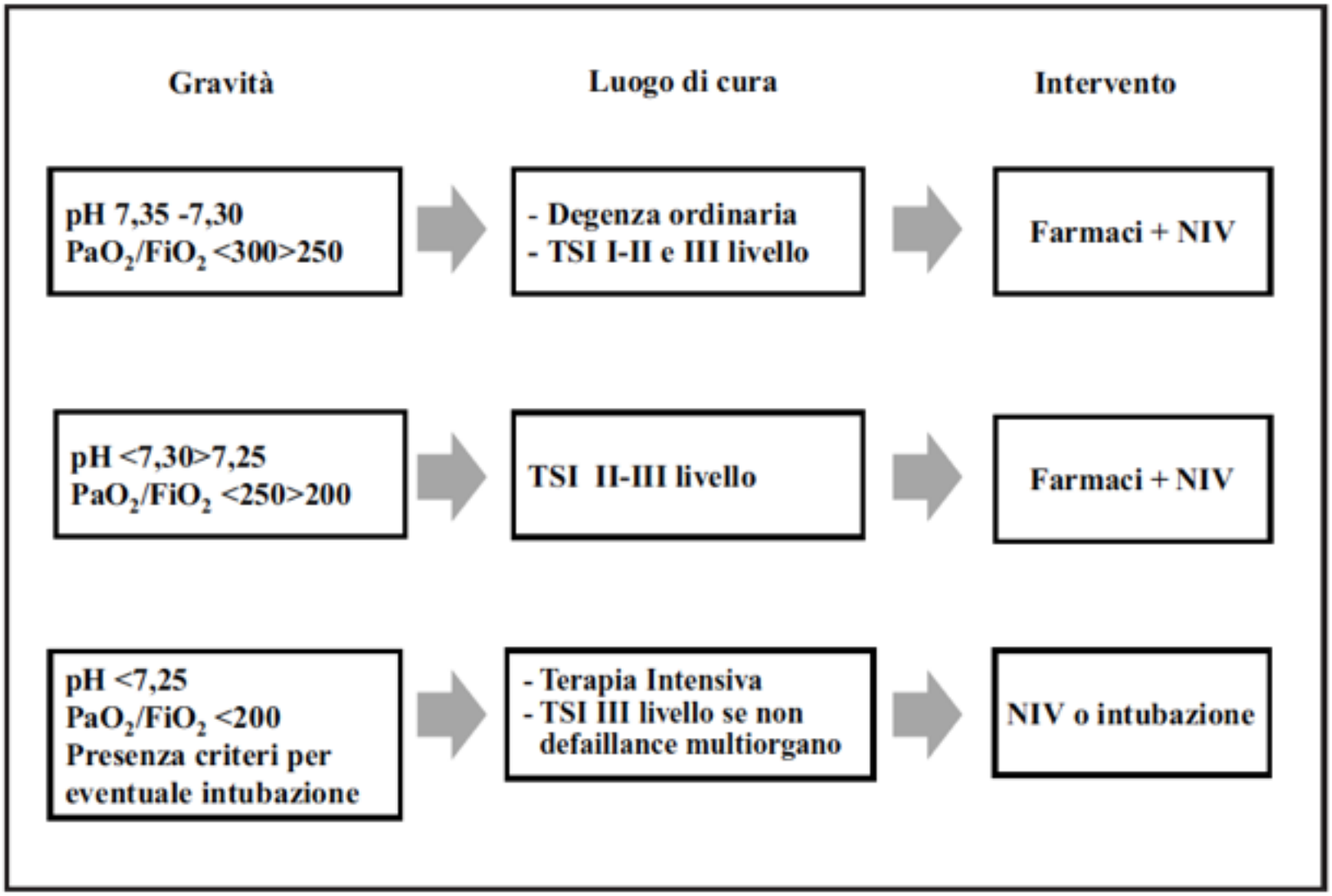


Fig. 17.1 Flow-chart della applicazione della NIV in ospedale

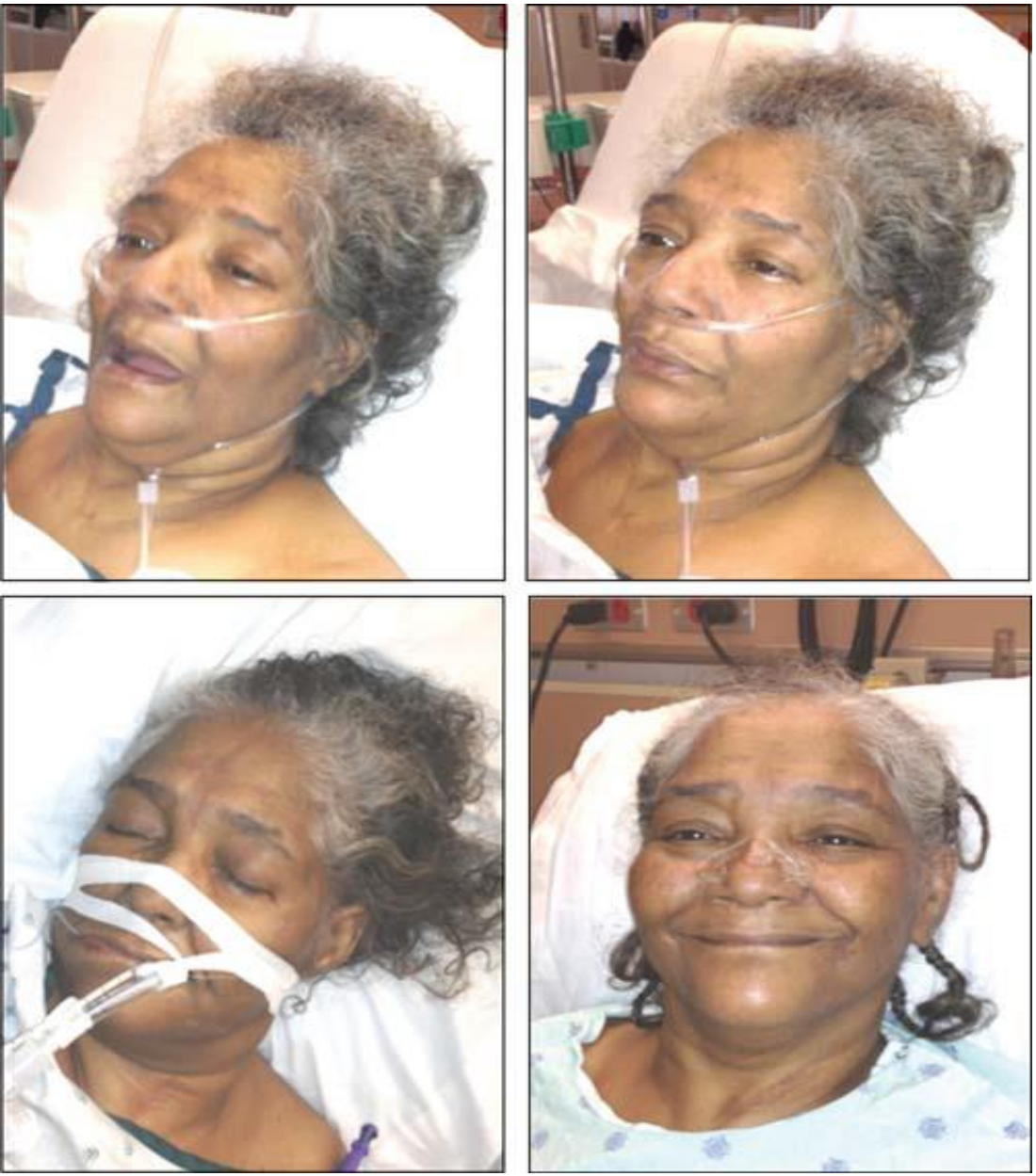


FIGURE 4-3 Change in facial appearance during the development and resolution of acute respiratory failure resulting from congestive heart failure and exacerbation of chronic obstructive pulmonary disease. Left upper panel: The patient is dyspneic and her mouth is open on inhalation. Right upper panel: The patient exhibits pursedlip breathing on exhalation. Over the ensuing 24 hours, the patient developed hypercapnic respiratory failure and failed a trial of noninvasive ventilation (not shown). Left lower panel: The patient is intubated and receiving mechanical ventilation. Right lower panel: The patient is successfully extubated 4 days after institution of mechanical ventilation.

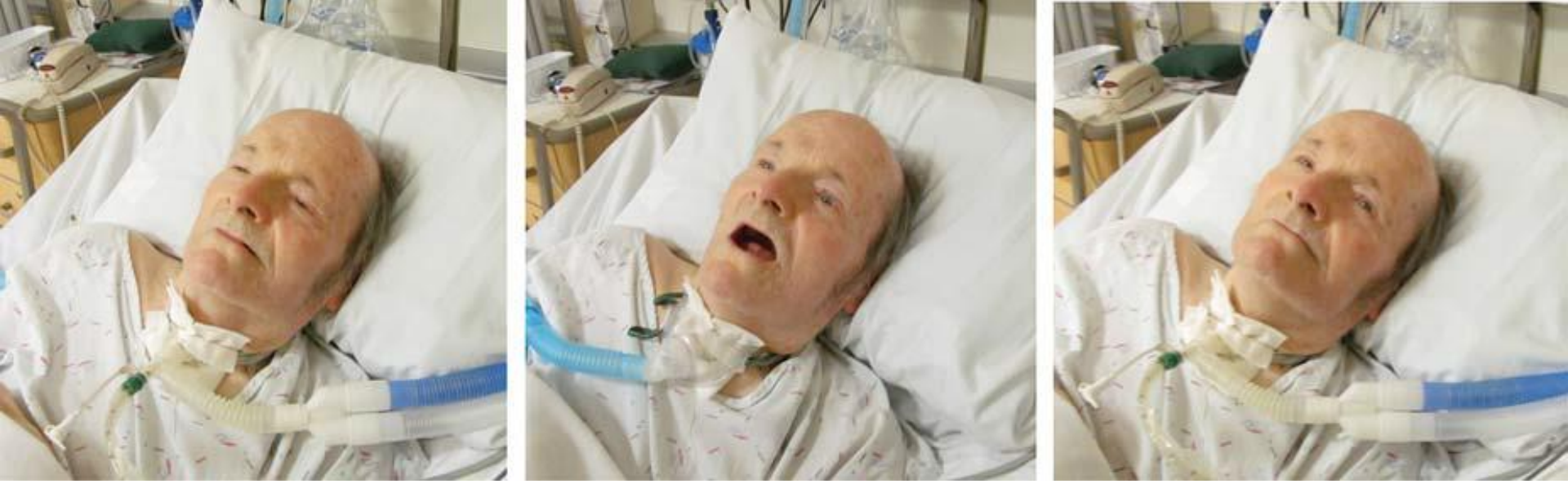


FIGURE 4-4 Change in the configuration of the mouth in a patient with a tracheostomy who becomes dyspneic.
Left: The patient is resting during full ventilator support and his mouth is closed.
Middle: Twelve minutes after disconnection from the ventilator, the patient has developed dyspnea and anxiety and his mouth is open.
Right: Thirty minutes after reconnection to the ventilator, the patient's respiratory distress has resolved and his mouth is closed.

RESTRICTIVE LUNG DISEASES

Restrictive lung diseases are characterized by reduced lung volumes, either because of an alteration in lung parenchyma or because of a disease of the pleura, chest wall, or neuromuscular apparatus.

Restrictive disease are associated with a decreased TLC. Measures of expiratory airflow are preserved and airway resistance is normal and the forced expiratory volume in 1 second (FEV1)/forced vital capacity (FVC) ratio is increased.

If caused by parenchymal lung disease, restrictive lung disorders are accompanied by reduced gas transfer, which may be marked clinically by desaturation after exercise.

The disorders that cause reduction or restriction of lung volumes may be divided into two groups based on anatomical structures.

Intrinsic lung diseases or diseases of the lung parenchyma.

Extrinsic disorders or extrapulmonary diseases.

RESTRICTIVE LUNG DISEASES

Extrinsic disorders

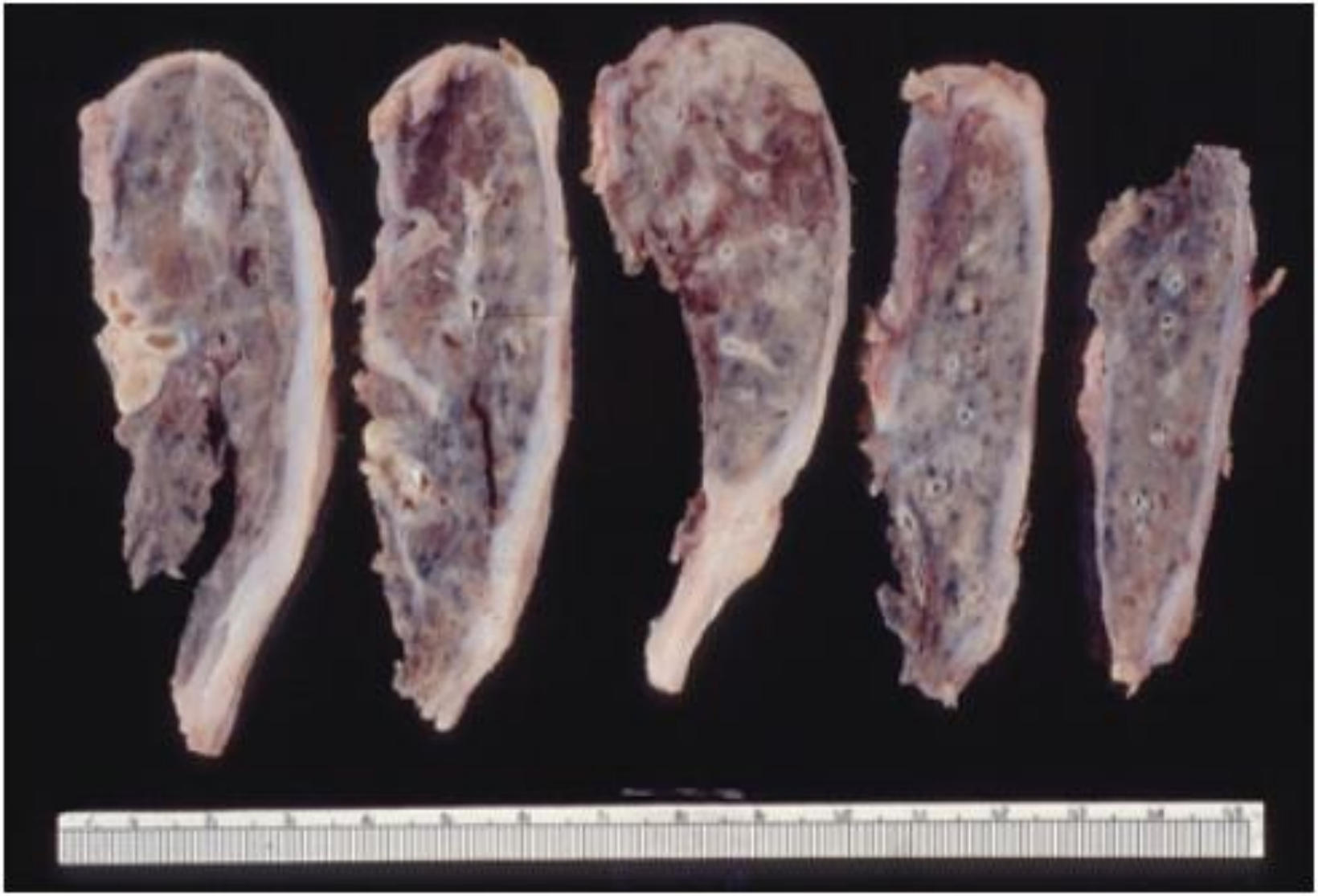
Non muscolar diseases of the chest wall, in which kyphoscoliosis can be idiopatic or secondary, may cause restrictive lung disease.

The most common cause of secondary kyphoscoliosis Is neuromuscular disease (polio, muscular dystrophy)

Fibrothorax, massive pleural effusion, morbid obesity Ankylosing spondylitis and thoracoplasty are other causes

Intrinsic lung diseases or diseases of the lung parenchyma.
The diseases cause inflammation or scarring of the lung tissue (interstitial lung disease) or result in filling of the air spaces with exudate and debris (pneumonitis).

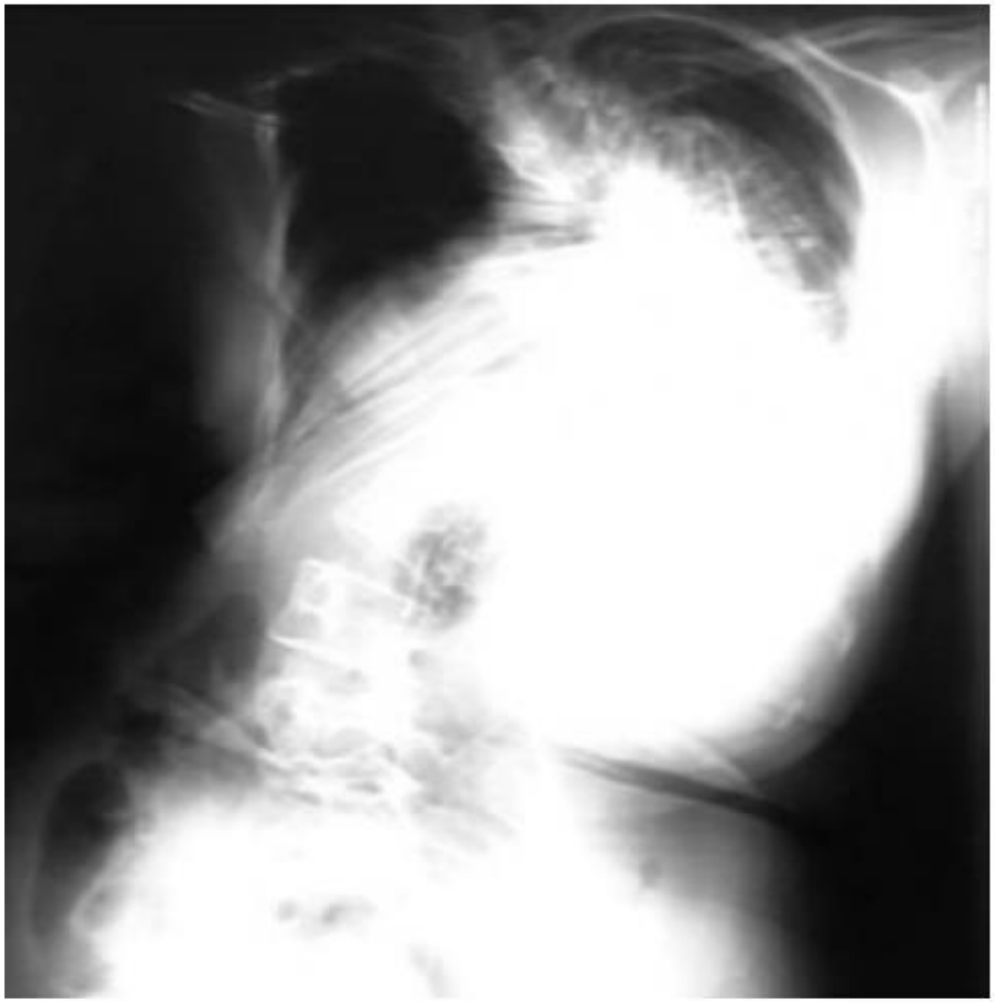
These diseases can be characterized according to etiological factors.
They include idiopathic fibrotic diseases, connective tissue diseases, drug induced lung disease, environmental exposures (inorganic and organic dusts), and primary diseases of the lungs (including sarcoidosis).



Extrinsic disorders or extrapulmonary diseases.

The chest wall, pleura, and respiratory muscles are the components of the respiratory pump, and they need to function normally for effective ventilation.

Diseases of these structures result in lung restriction, impaired ventilatory function, and respiratory failure (eg, nonmuscular diseases of the chest wall, neuromuscular disorders).

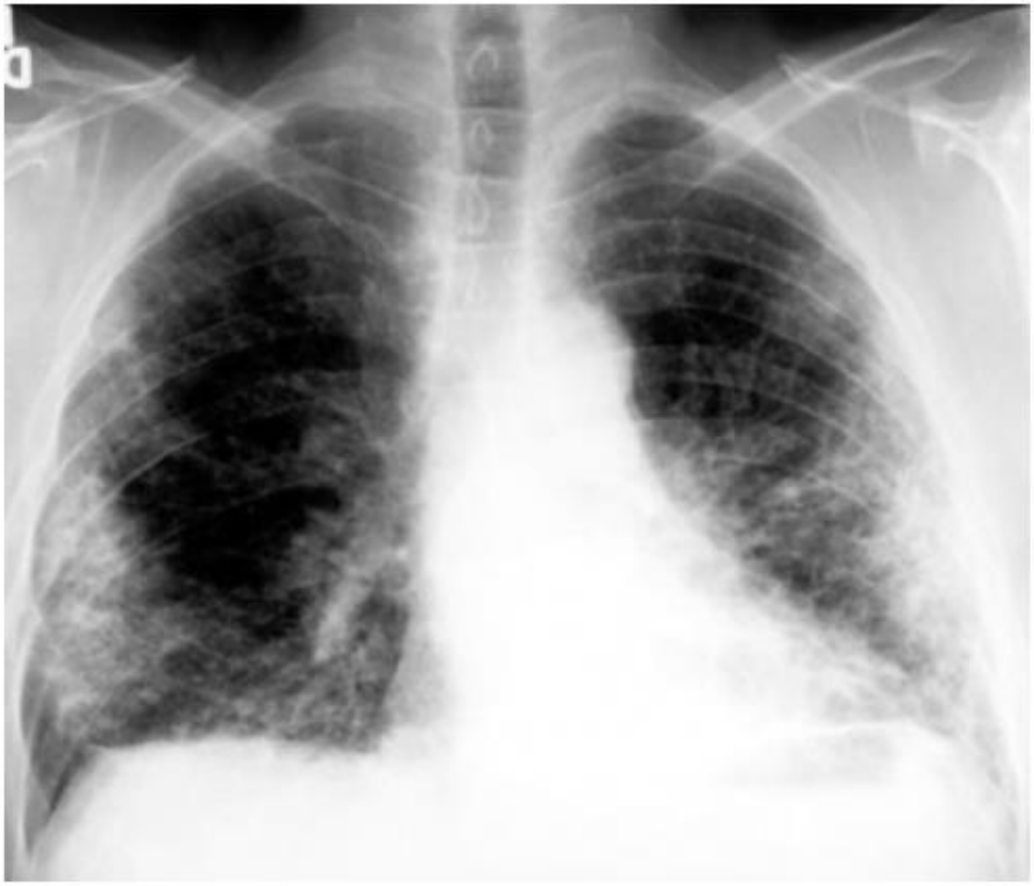


Chest radiograph from a 39-year-old woman with severe kyphoscoliosis who developed hypercapnic respiratory failure. Spirometry findings showed a severe restrictive lung disease, with a forced expiratory volume in one second of 0.4 L/s and a forced vital capacity of 0.5 L.

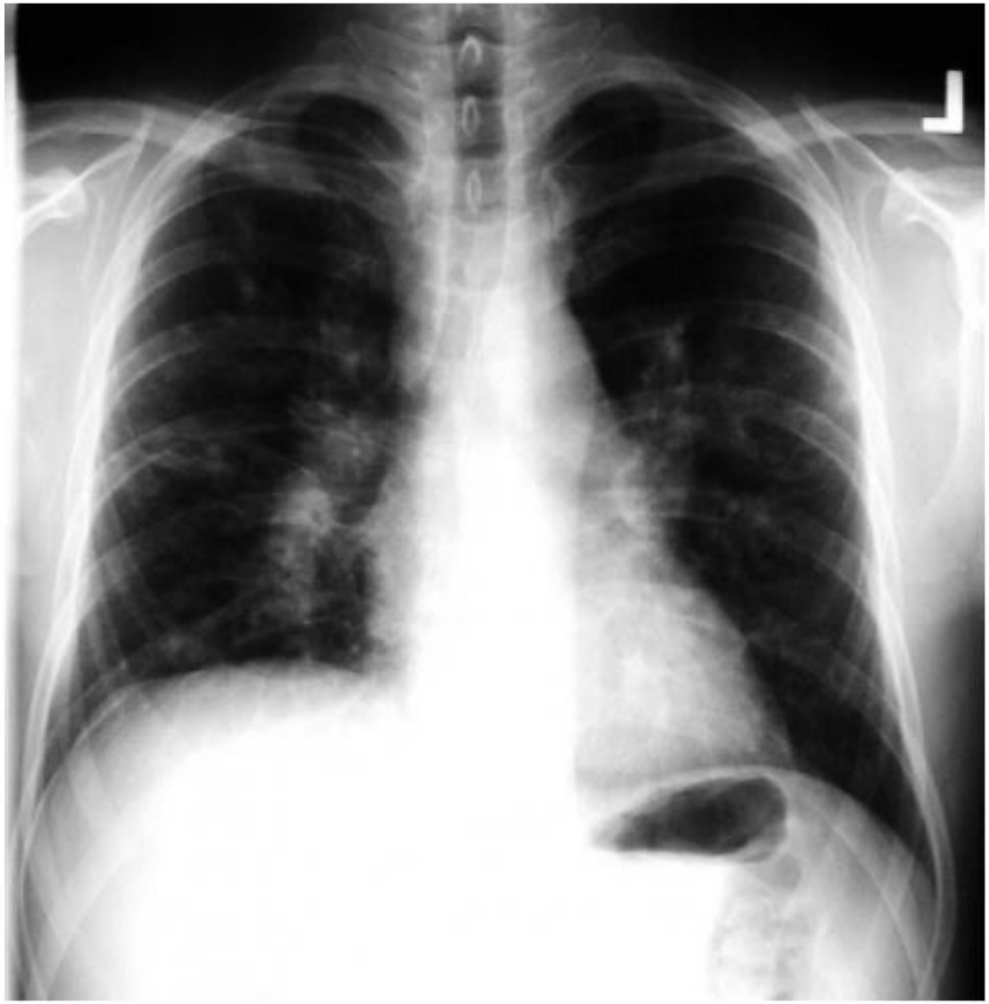
The mnemonic "PAINT" has been used to divide the causes of restrictive lung disease into

Pleural
Alveolar
Interstitial
Neuromuscular
Thoracic cage abnormalities

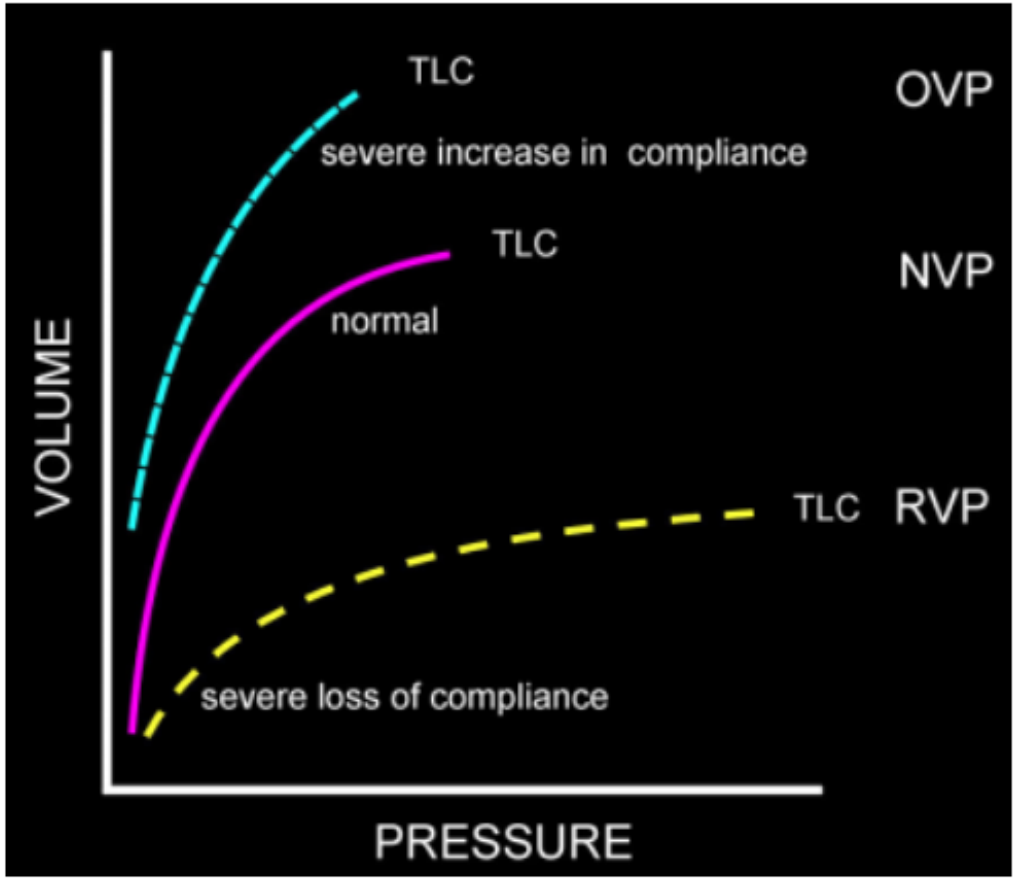
CAUSES	EXAMPLES	DIAGNOSIS	PFT FINDINGS
PLEURAL	TRAPPED LUNG, PLEURALSCARRING LARGE PLEURAL EFFUSIONS CHRONIC EMPYEMA ASBESTOSIS	RX, TC, PLEURAL MANOMETRY,, PLEURAL BIOPSY	LOW RVA, LOW TLC, LOW FVC
ALVEOLAR	EDEMA, EMORRHAGE	RX, TC PHYSICAL EXAMINATION	INCREASED DLCO IN HEMORRAGE (INTRAPULMONARY HEMOGLOBIN ABSORBS THE CABON MONOXIDE, THUS INCREASING THE DLCO READINGS
INTERSTITIAL	INTERSTITIAL LUNG DISEASE INCLUDING IPFC NSIPD COP	RX , TC PHYSICAL EXAMINATION, ECHO OFTEN SHOWS PULMONARY HYPERTENSION	LOW RVA, LOW TLC, LOW FVC, DEREASED DLCO, POOR LUNG COMPLIANCE
NEUROMUSCOLAR	MYASTENIA GRAVIS, ALS, MYOPATHY	PHYSICAL EXAMINATION, EMGSG, SEROLOGY	LOW RV, LOW TLC, LOW NIFH, LOW MMVI
THORACIC/ EXTRATHORACIC	OBESITY, KYPHOSCOLIOSIS, ASCITIS	PHYSICAL EXAMINATION	LOW ERV AND FRC IN OBESITY, LOW VC,TLC FRC IN KYPHOSCOLIOSIS



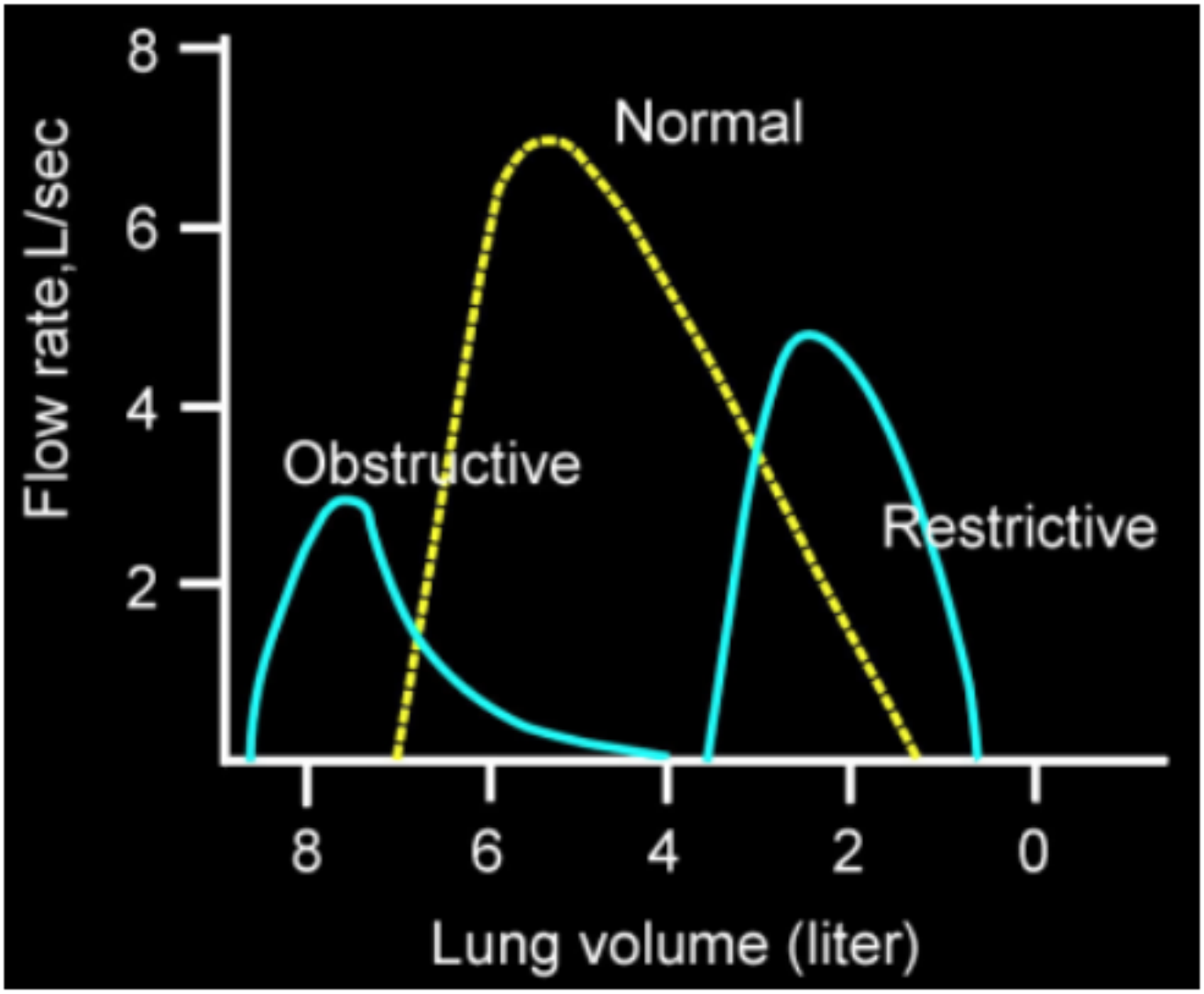
Chest radiograph of a 67-year-old man diagnosed with idiopathic pulmonary fibrosis, based on open lung biopsy findings. Extensive bilateral reticulonodular opacities are seen in both lower lobes.



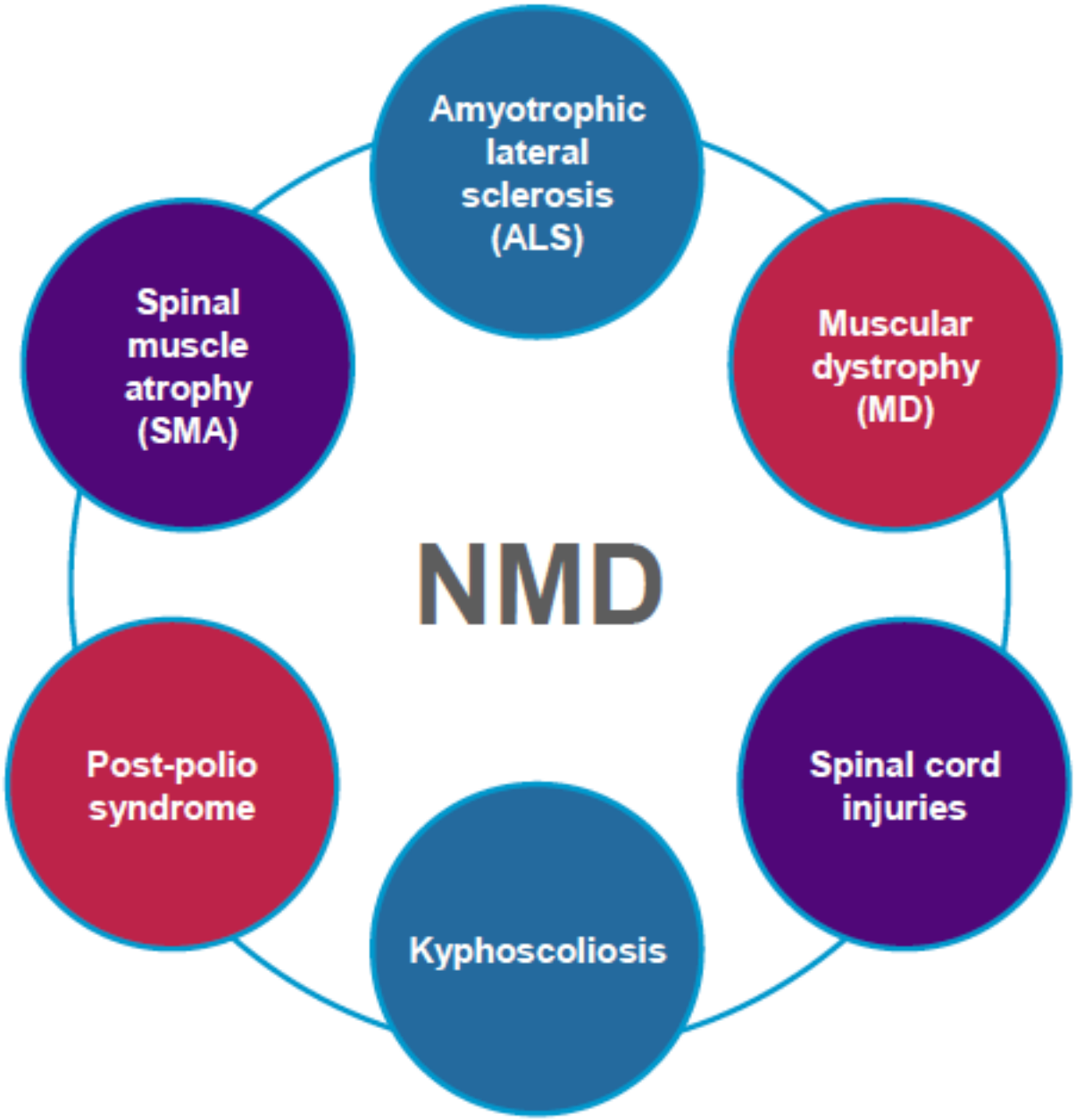
A chest radiograph of stage III sarcoidosis. This stage refers to pulmonary infiltrates without evidence of mediastinal lymphadenopathy.



Lung volume is plotted against transpulmonary pressure. Compliance is the change in volume for a given change in pressure. A patient with emphysema has a higher lung compliance compared with a patient with no lung disease, while a patient with restrictive lung disease has a reduction in compliance.



Idealized flow volume curves for normal, obstructive, and restrictive lungs.


Amyotrophic lateral sclerosis (ALS)
Spinal muscle atrophy (SMA)
Muscular dystrophy (MD)
NMD
Post-polio syndrome
Spinal cord injuries
Kyphoscoliosis

ResMed

Amyotrophic lateral sclerosis (ALS) is a group of rare neurological diseases that mainly involve the nerve cells (neurons) responsible for controlling voluntary muscle movement.

The disease is progressive, meaning the symptoms get worse over time. Currently, there is no cure for ALS and no effective treatment to halt, or reverse, the progression of the disease.

ALS belongs to a wider group of disorders known as motor neuron diseases, which are caused by gradual deterioration (degeneration) and death of motor neurons. Motor neurons are nerve cells that extend from the brain to the spinal cord and to muscles throughout the body. These motor neurons initiate and provide vital communication links between the brain and the voluntary muscles.

In ALS, both the upper motor neurons and the lower motor neurons degenerate or die, and stop sending messages to the muscles. Unable to function, the muscles gradually weaken, start to twitch (called fasciculations), and waste away (atrophy). Eventually, the brain loses its ability to initiate and control voluntary movements.

Early symptoms of ALS usually include muscle weakness or stiffness. Gradually all muscles under voluntary control are affected, and individuals lose their strength and the ability to speak, eat, move, and even breathe.

Most people with ALS die from respiratory failure, usually within 3 to 5 years from when the symptoms first appear.

However, about 10 percent of people with ALS survive for 10 or more years.

ERJ open research

ORIGINAL ARTICLE
NEUROMUSCULAR DISEASE

Bulbar impairment score and survival of stable amyotrophic lateral sclerosis patients after noninvasive ventilation initiation

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ABSTRACT There is general agreement that noninvasive ventilation (NIV) prolongs survival in amyotrophic lateral sclerosis (ALS) and that the main cause of NIV failure is the severity of bulbar dysfunction. However, there is no evidence that bulbar impairment is a contraindication for NIV. The aim of this study was to determine the effect of bulbar impairment on survival in ALS patients with NIV.

ALS patients for whom NIV was indicated were included. Those patients who refused NIV were taken as the control group.

120 patients who underwent NIV and 20 who refused NIV were included. The NIV group presented longer survival (median 18.50 months, 95% CI 12.62–24.38 months) than the no-NIV group (3.00 months, 95% CI 0.82–5.18 months) ($p<0.001$) and also in those patients with severe bulbar dysfunction (13.00 months (95% CI 9.49–16.50 months) versus 3.00 months (95% CI 0.85–5.15 months), $p<0.001$). Prognostic factors for ALS using NIV, adjusted for NIV failure, were severity of bulbar dysfunction (hazard ratio (HR) 0.5, 95% CI 0.92–0.97; $p=0.001$) and time spent with oxygen saturation measured by pulse oximetry <90% (%sleepS_pO_2<90) using NIV (HR 1.12, 95% CI 1.01–1.24; $p=0.02$).

Severe bulbar impairment in ALS does not always prevent NIV from being used, but the severity of bulbar dysfunction at NIV initiation and %sleepS_pO_2<90 while using NIV appear to be the main prognostic factors of NIV failure in ALS.

@ERSpublications
NIV prolongs survival in some ALS patients with severe bulbar impairment at NIV indication
http://ow.ly/vFe530iCwnj

Cite this article as: Sancho J, Martínez D, Bures E, *et al*. Bulbar impairment score and survival of stable amyotrophic lateral sclerosis patients after noninvasive ventilation initiation. *ERJ Open Res* 2018; 4: 00159-2017 [https://doi.org/10.1183/23120541.00159-2017].

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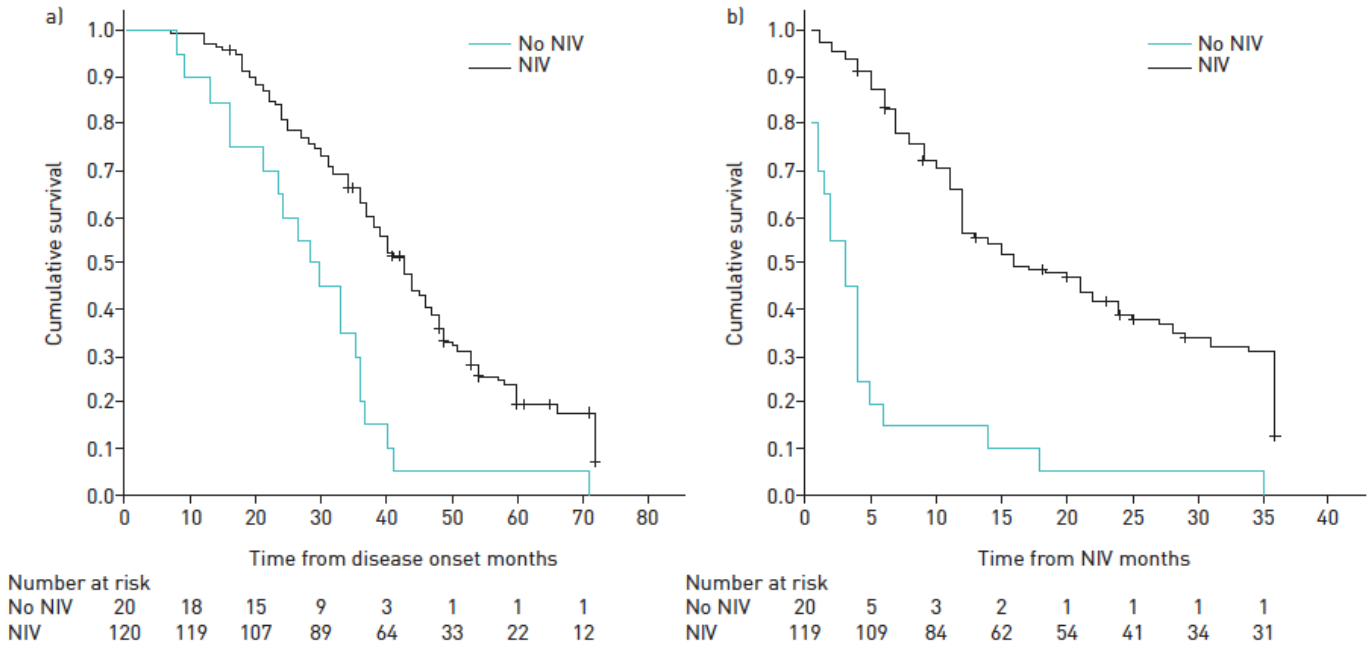

FIGURE 2 Survival without tracheostomy a) from disease onset and b) from noninvasive ventilation (NIV) indication. Total population.

FIGURE 2 Survival without tracheostomy
a) from disease onset and
b) from noninvasive ventilation (NIV) indication.

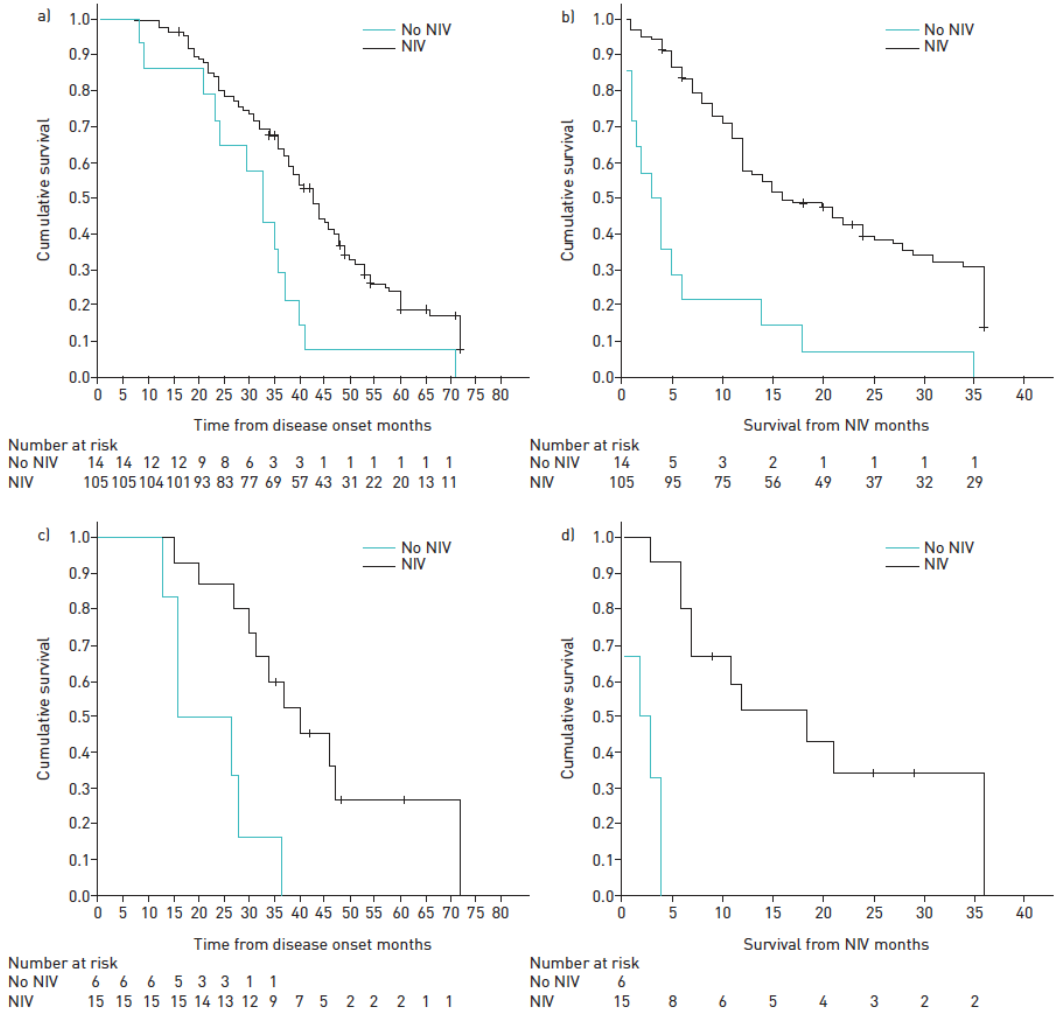

FIGURE 3 Survival without tracheostomy. a) Patients with no or moderate bulbar dysfunction from disease onset. b) Patients with no or moderate bulbar dysfunction from noninvasive ventilation (NIV) indication. c) Patients with severe bulbar dysfunction from disease onset. d) Patients with severe bulbar dysfunction from NIV indication.

FIGURE 3 Survival without tracheostomy.
a) Patients with no or moderate bulbar dysfunction from disease onset.
b) Patients with no or moderate bulbar dysfunction from noninvasive ventilation (NIV) indication.
c) Patients with severe bulbar dysfunction from disease onset.
d) Patients with severe bulbar dysfunction from NIV indication.

In conclusion, NIV is able to prolong survival in ALS patients, including in some of those with severe bulbar dysfunction at NIV indication.

The severity of bulbar dysfunction at NIV initiation and % sleep SpO2<90 while using NIV are the prognostic factors for NIV failure in ALS patients.

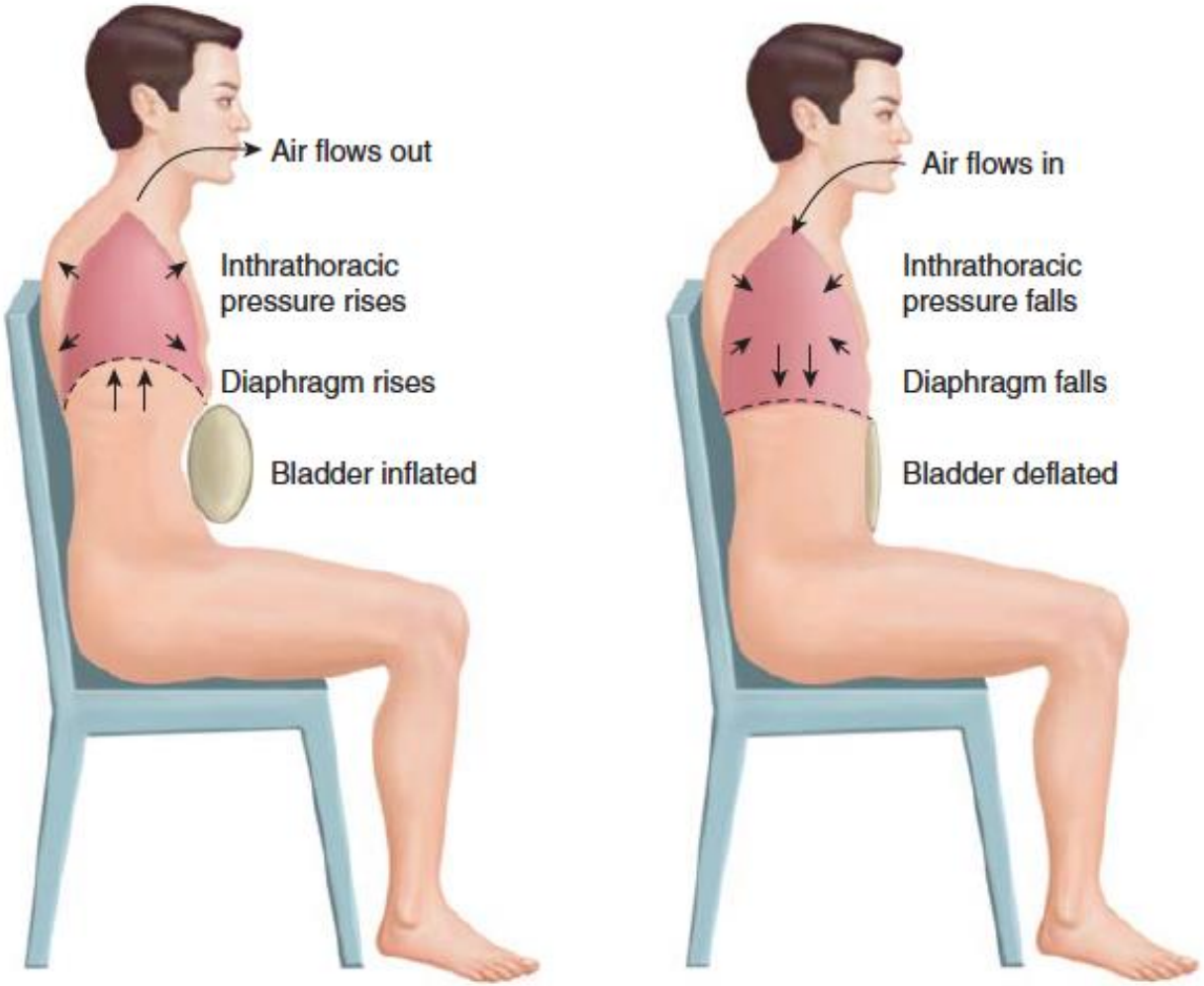

FIGURE 17-5 The pneumobelt functions by exerting positive pressure on the abdominal viscera, forcing the diaphragm up and assisting exhalation (*left*). When the bladder deflates, gravity returns the diaphragm to its original position, assisting inhalation (*right*). (Reproduced with the permission from the American College of Chest Physicians. Hill NS. Clinical applications of body ventilators. *Chest.* 1986;90:897–905.)

Curr Opin Crit Care. 2016 Apr;22(2):94-9. doi: 10.1097/MCC.0000000000000284.

Noninvasive ventilation for neuromuscular respiratory failure: when to use and when to avoid.

Rabinstein AA[1].

Abstract

PURPOSE OF REVIEW: Neuromuscular respiratory failure can occur from a variety of diseases, both acute and chronic with acute exacerbation. There is often a misunderstanding about how the nature of the neuromuscular disease should affect the decision on how to ventilate the patient. This review provides an update on the value and relative contraindications for the use of noninvasive ventilation in patients with various causes of primary neuromuscular respiratory failure.

Curr Opin Crit Care. 2016 Apr;22(2):94-9. doi: 10.1097/MCC.0000000000000284.

Noninvasive ventilation for neuromuscular respiratory failure: when to use and when to avoid.

Rabinstein AA[1].

RECENT FINDINGS: Myasthenic crisis represents the paradigmatic example of the neuromuscular condition that can be best treated with noninvasive ventilation. Timely use of noninvasive ventilation can substantially reduce the duration of ventilatory assistance in these patients. Noninvasive ventilation can also be very helpful after extubation in patients recovering from an acute cause of neuromuscular respiratory failure who have persistent weakness. Noninvasive ventilation can improve quality of survival in patients with advanced motor neuron disorder (such as amyotrophic lateral sclerosis) and muscular dystrophies, and can avoid intubation when these patients present to the hospital with acute respiratory failure. Attempting noninvasive ventilation is not only typically unsuccessful in patients with Guillain-Barre syndrome, but can also be dangerous in these cases.

SUMMARY: Noninvasive ventilation can be very effective to treat acute respiratory failure caused by myasthenia gravis and to prevent reintubation in other neuromuscular patients, but should be used cautiously for other indications, particularly Guillain-Barre syndrome.

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Kyphoscoliosis — what can we do for respiration besides NIV?

The authors declare no financial disclosure

Abstract

Kyphoscoliosis (KS) is a significant clinical problem with no precise guidelines for management, especially concerning respiratory pathology. No exhaustive systematic review has yet been performed. The aim was to conduct a systematic review of available data concerning the pathophysiology and treatment of kyphoscoliosis.

An electronic systematic search compliant with Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines was conducted. The Pubmed database was examined and the search was updated to November 10, 2016. In total, 188 articles were screened, and 52 full text articles were then assessed for eligibility. As 24 of them met exclusion criteria, only 28 articles were further analysed. These articles were published in 18 journals from 1959 to 2015, with 25 being original studies, and one randomised control trial. The total corpus included 18 prospective studies, 7 retrospective studies and 3 case reports.

KS is a significant complex, multidisciplinary clinical problem. The heterogeneous nature of the majority of published studies prevents unequivocal conclusions being drawn. Despite a great progress in knowledge about the respiratory system functioning and pathology in KS, the treatment seems to be not yet quite satisfactory. Therefore, there is a strong need for large prospective studies and unified clinical guidelines on the management of this group of patients.

Key words: kyphoscoliosis, respiratory failure, non-invasive ventilation, NIV, treatment

Adv. Respir. Med. 2017; 85: 352–357

Kyphoscoliosis (KS) is an excessive curvature of the spine in the coronal and sagittal plane caused by vertebral anomalies [1].

It affects about 1% of the population but only 10% of the cases present significant clinical symptoms. Most KS cases are mild and have no impact on everyday life of the patient [2].

The aetiology of KS remains uncertain.
It may eventuate due to traumatic injury in childhood,
tuberculosis of the spine,
post-rachitic
neuromuscular kyphoscoliosis due to poliomyelitis in infancy;

the most common form is idiopathic kyphoscoliosis [4, 5].

Patients with KS have a characteristic body appearance characterised by a short stature due to reduction of the rib cage and trunk, and the presence of a hump created by the deformed thoracic cavity.

The severity of KS is judged by the Cobb angle, which can be estimated by the angle formed by the intersection of two lines: a perpendicular to a line drawn across the superior endplate of the upper-end vertebra, and the inferior endplate of the lower-end vertebra of the deformity [5].

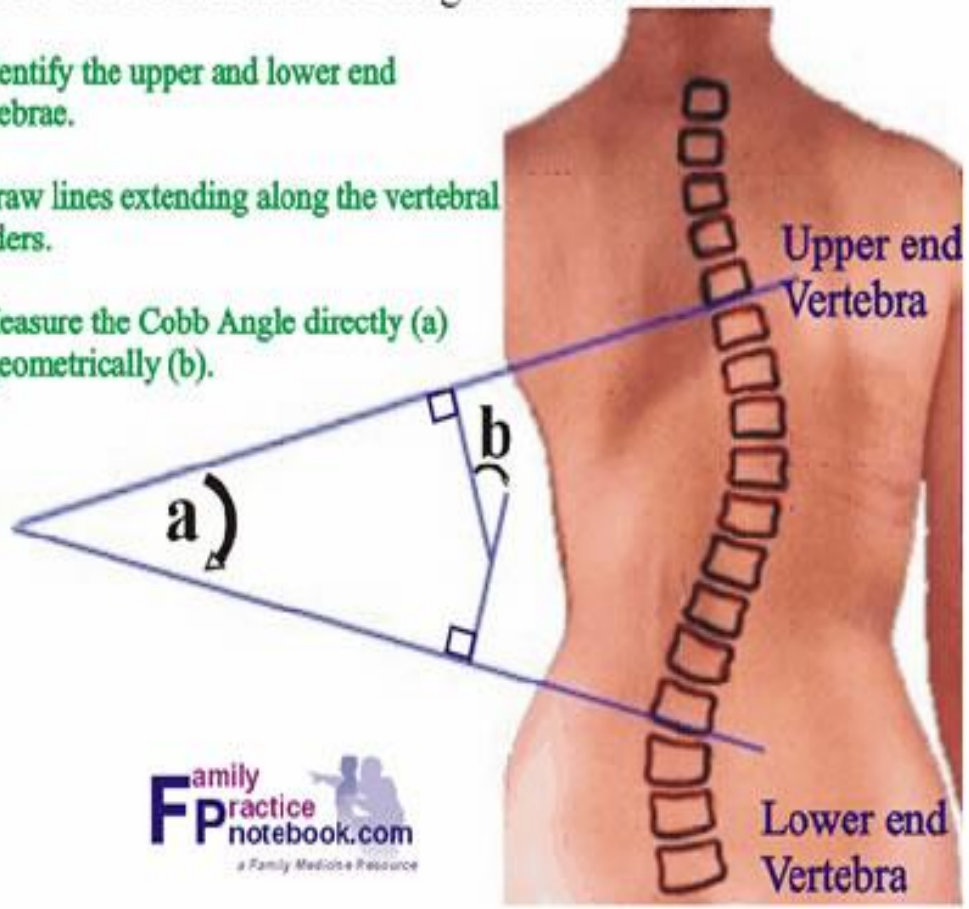
Scoliosis Radiographs

The Cobb Method of angle measurement

1. Identify the upper and lower end vertebrae.

2. Draw lines extending along the vertebral borders.

3. Measure the Cobb Angle directly (a) or geometrically (b).



The most extreme deformities have been observed due to tuberculosis KS and polio KS [2].

The patients demonstrate a greater risk of muscle fatigue associated with ageing, and their chest wall compliance decreases [1].

These changes lead to impairment of the respiratory system and cause hypoventilation, hypercapnia and pulmonary hypertension, finally resulting in chronic respiratory failure (CRF) [6, 7].

The first to describe the influence of ventilation on the condition of patients during ARF was the study performed in 1995 by Finlay et al. [23], who identified improved blood oxygen concentration (PaO_2) and reduced blood carbon dioxide concentration ($PaCO_2$) after nasal intermittent positive pressure ventilation.

NIV also ameliorated FEV1 and FVC, as well as FEV1 after discharge from hospital.

Indicators for NIV failure include lower pH and lower PaO_2/FiO_2 ratio after one hour of NIV usage [4].

NIV is now regarded as an option of treating CRF in patients with KS [4]. Gustafson et al. [24] also have reported that the survival rate of patients using home mechanical ventilation was three times higher than that of patients using long-term oxygen therapy alone (LTOT).

The choice of treatment depends on the comorbidities and underlying condition. If the patient has obstructive disorders, continuous positive airways pressure (CPAP) is recommended; however, this may not be sufficient in other kinds of respiratory pathology. Then, NIV is recommended.

Summary

KS is a significant complex, multidisciplinary clinical problem.
The results of the majority of published studies are heterogeneous, which currently prevents unequivocal conclusions from being drawn.
Coming back to the question asked in the title: what can we do for respiration besides NIV?
The answer is: little.
Although the deformity is probably known from antiquity, and despite a great progress in knowledge about the respiratory system functioning and pathology in KS, the treatment seems to be not yet quite satisfactory.
Therefore, there is a strong need for large control trials and unified clinical guidelines on the management of this group of patients.

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BTS/ICS Guidelines for the Ventilatory Management of Acute Hypercapnic Respiratory Failure in Adults

British Thoracic Society/Intensive Care Society Acute Hypercapnic Respiratory Failure Guideline Development Group

NMD and CWD

Respiratory impairment generally parallels disease progression in NMD.

In some, diaphragm involvement precedes locomotor disability and presentation with acute on chronic hypercapnia is typical.

This pattern is characteristic of acid maltase deficiency and the amyotrophic lateral sclerosis variety of motor neurone disease.

NICE had previously published guidance on the use of NIV in motor neurone disease, which did not consider management of acute illness nor the value of intubation if NIV fails.

New guidance from NICE on motor neurone disease is in preparation.

Without domicilary NIV, the natural history of neuromuscular and CWDs is of progressive chronic hypercapnic failure leading to death.

It is well recognised such individuals can survive long term on home NIV with a good QoL, even if they present initially in severe respiratory failure.

- Individuals with NMD and CWD who present with AHRF should not be denied acute NIV.

- NIV is the ventilation mode of choice because patients with NMD or CWD tolerate it well and because extubation from IMV may be difficult.

- In patients with NMD or CWD, deterioration may be rapid
or sudden, making HDU/ICU placement for therapy more appropriate.

- In patients with NMD or CWD, senior/experienced input is
needed in care planning and is essential if differences in opinion exist or develop between medical staff and patient representatives.

- In patients with NMD, it should be anticipated that bulbar dysfunction and communication difficulties, if present, will make NIV delivery difficult and may make it impossible.

- Discussion about NIV and IMV, and patients' wishes with respect to cardiopulmonary resuscitation, should occur as part of routine care in patients with NMD or CWD.

- In patients with NMD or CWD, nocturnal NIV should usually be continued following an episode of AHRF pending

- Discussion about NIV and IMV, and patients wishes with respect to cardiopulmonary resuscitation, should occur as part of routine care in patients with NMD or CWD.

- In patients with NMD or CWD, nocturnal NIV should usually be continued following an episode of AHRF pending discussion with a home ventilation service.

- In patients with NMD or CWD, intolerance of the mask and severe dyspnoea are less likely to cause NIV failure. Bulbar dysfunction makes NIV failure more likely.

- Deterioration in patients with NMD or CWD may be very sudden. Difficulty achieving adequate oxygenation or rapid desaturation during a break from NIV are important warning signs.

- In patients with NMD or CWD, the presence of bulbar dysfunction, more profound hypoxaemia or rapid desaturation during NIV breaks suggests that placement in HDU/ICU is indicated.

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

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ERS/ATS evidence-based recommendations for the use of noninvasive ventilation in acute respiratory failure http://ow.ly/NrqB30dAYSQ

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ABSTRACT Noninvasive mechanical ventilation (NIV) is widely used in the acute care setting for acute respiratory failure (ARF) across a variety of aetiologies. This document provides European Respiratory Society/American Thoracic Society recommendations for the clinical application of NIV based on the most current literature.

The guideline committee was composed of clinicians, methodologists and experts in the field of NIV. The committee developed recommendations based on the GRADE (Grading, Recommendation, Assessment, Development and Evaluation) methodology for each actionable question. The GRADE Evidence to Decision framework in the guideline development tool was used to generate recommendations. A number of topics were addressed using technical summaries without recommendations and these are discussed in the supplementary material.

This guideline committee developed recommendations for 11 actionable questions in a PICO (population–intervention–comparison–outcome) format, all addressing the use of NIV for various aetiologies of ARF. The specific conditions where recommendations were made include exacerbation of chronic obstructive pulmonary disease, cardiogenic pulmonary oedema, *de novo* hypoxaemic respiratory failure, immunocompromised patients, chest trauma, palliation, post-operative care, weaning and post-extubation.

This document summarises the current state of knowledge regarding the role of NIV in ARF. Evidence-based recommendations provide guidance to relevant stakeholders.

This article has supplementary material available from erj.ersjournals.com

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This document was endorsed by the ERS Executive Committee in July 2017 and approved by the ATS Board of Directors in June 2017.

The guidelines published by the European Respiratory Society (ERS) incorporate data obtained from a comprehensive and systematic literature review of the most recent studies available at the time. Health professionals are encouraged to take the guidelines into account in their clinical practice. However, the recommendations issued by this guideline may not be appropriate for use in all situations. It is the individual responsibility of health professionals to consult other sources of relevant information, to make appropriate and accurate decisions in consideration of each patient's health condition and in consultation with that patient and the patient's caregiver where appropriate and/or necessary, and to verify rules and regulations applicable to drugs and devices at the time of prescription.

Conflict of interest: Disclosures can be found alongside this article at erj.ersjournals.com

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TABLE 2 Recommendations for actionable PICO questions

Clinical indication[#]	Certainty of evidence[¶]	Recommendation
Prevention of hypercapnia in COPD exacerbation	⊕⊕	Conditional recommendation against
Hypercapnia with COPD exacerbation	⊕⊕⊕⊕	Strong recommendation for
Cardiogenic pulmonary oedema	⊕⊕⊕	Strong recommendation for
Acute asthma exacerbation		No recommendation made
Immunocompromised	⊕⊕⊕	Conditional recommendation for
***De novo* respiratory failure**		No recommendation made
Post-operative patients	⊕⊕⊕	Conditional recommendation for
Palliative care	⊕⊕⊕	Conditional recommendation for
Trauma	⊕⊕⊕	Conditional recommendation for
Pandemic viral illness		No recommendation made
Post-extubation in high-risk patients (prophylaxis)	⊕⊕	Conditional recommendation for
Post-extubation respiratory failure	⊕⊕	Conditional recommendation against
Weaning in hypercapnic patients	⊕⊕⊕	Conditional recommendation for

[#]: all in the setting of acute respiratory failure; [¶]: certainty of effect estimates: ⊕⊕⊕⊕, high; ⊕⊕⊕, moderate; ⊕⊕, low; ⊕, very low.

Should NIV be used in de novo ARF?

De novo respiratory failure refers to respiratory failure occurring without prior chronic respiratory disease.
Most patients in this category have hypoxaemic respiratory failure, usually defined as

significant hypoxaemia (arterial oxygen tension/inspiratory oxygen fraction ratio (PaO2/FIO2) $\leqslant$200),
tachypnoea (respiratory rate >30–35 breaths·min–1) and a

non-COPD diagnosis (e.g. pneumonia and/or acute respiratory distress syndrome (ARDS)).

We considered studies on patients with hypoxaemic respiratory failure, community-acquired pneumonia and ARDS

NIV is used in these patients with the aims of

improving oxygenation,
facilitating ventilation,
decreasing the work of breathing and dyspnoea,
avoiding intubation,
reducing the complications associated with invasive mechanical ventilation.

Limitations of NIV in achieving some of these aims relative to invasive ventilation in patients with de novo ARF include its lack of efficacy in reducing work of breathing, in contrast to hypercapnic respiratory failure where its ability to reduce work of breathing has been clearly demonstrated.

In ARDS patients, it has been shown that the use of noninvasive inspiratory pressure support can decrease the inspiratory effort compared with no inspiratory assistance only if sufficient pressure support is added [69]. Of concern, the tidal volume can also be significantly higher during NIV, especially when substantial inspiratory pressure is delivered, and further exacerbated by the high inspiratory demand seen in patients with acute hypoxic respiratory failure [70].

The total pressure dissipated to inflate the lungs can be excessive during NIV. Such large transpulmonary pressures and the resulting large tidal volumes may exacerbate lung injury if prolonged over time. It is possible, although not proven, that NIV is especially useful in patients who do not substantially increase their tidal volume, but further work is needed in this area [71].

Potential uses of NIV for de novo ARF include as a preventive strategy for avoiding intubation.
One pilot study on patients with “early” ARDS (PaO_2/FIO_2 >200 and ⩽300) showed avoidance of intubation and reduced cytokine levels as favourable outcomes [83]. However, this study has not been replicated.

NIV has also been studied as an alternative to intubation, with occasional reports showing benefit [84].

The main risk of NIV for the indication of de novo ARF is to delay a needed intubation [86].
Early predictors of NIV failure include higher severity score, older age, ARDS or pneumonia as the aetiology for respiratory failure, or a failure to improve after 1 h of treatment.

Although the reasons for a poorer outcome are not completely understood, patients with NIV failure have higher tidal volumes before intubation [71] and develop more complications after intubation [90].

Studies have shown that NIV failure is an independent risk factor for mortality specifically in this population, although careful patient selection seems to reduce this risk [91, 92].

Recommendation

Given the uncertainty of evidence we are unable to offer a recommendation on the use of NIV for de novo ARF.

Should NIV be used in ARF in the post-operative setting?

Surgery, particularly that approaching the diaphragm, anaesthesia and post-operative pain may all have deleterious effects on the respiratory system, causing hypoxaemia, a decrease in lung volume and atelectasis due to diaphragm dysfunction [93].

These modifications of respiratory function occur early after surgery and diaphragm dysfunction may last up to 7 days, leading to an important deterioration in arterial oxygenation [94].

Maintenance of adequate oxygenation and avoidance of symptoms of respiratory distress in the post-operative period are of major importance, especially when pulmonary complications such as ARF occur [95, 96].

Both bilevel NIV and CPAP are frequently used in these clinical situations.

Imaging studies have shown that the use of NIV may increase lung aeration and decrease the amount of atelectasis during the post-operative period of patients undergoing major abdominal surgery [93].

Physiological studies have shown that CPAP and bilevel NIV are effective at improving lung aeration and arterial oxygenation and decreasing the amount of atelectasis without adverse haemodynamic effects during the post-operative period after extubation [93, 97].

Supra-diaphragmatic surgery

One RCT demonstrated that in patients who developed respiratory failure during the post-operative period of lung cancer resection, NIV decreased the need for re-intubation and reduced hospital mortality [98].

STEPHAN et al. [96] reported that, in 830 patients following cardiothoracic surgery with or at risk for respiratory failure, the use of high-flow nasal cannula therapy compared with intermittent NIV did not result in a worse rate of treatment failure defined as need for re-intubation.

Abdominal and/or pelvic surgery

In patients who had respiratory failure after abdominal surgery, JABER et al. [99] reported that the use of NIV resulted in avoidance of intubation in 67% cases, and a reduction in the hospital length of stay and mortality, compared with intubated patients.

In a randomised trial on 40 patients undergoing solid organ transplantation (mainly liver transplantation) and developing post-operative respiratory failure, ANTONELLI et al. [60] found that NIV improved oxygenation and decreased the need for tracheal intubation compared with conventional therapy.

SQUADRONE et al. [100] evaluated the use of helmet-CPAP after abdominal surgery in 209 patients who developed hypoxaemia without respiratory symptoms immediately after extubation. Their early use of CPAP significantly decreased the incidence of re-intubation from 10% to 1% (p=0.005).

JABER et al. [95] recently reported the results of a multicentre RCT including 298 patients with hypoxaemic ARF following abdominal surgery. The use of NIV compared with standard oxygen therapy reduced the risk of tracheal re-intubation within 7 days (46% versus 33%; p=0.03) and the incidence of healthcare-associated infections (31% versus 49%; p=0.003).

Recommendation

We suggest NIV for patients with post-operative ARF. (Conditional recommendation, moderate certainty of evidence.)

Should NIV be used in patients with ARF receiving palliative care?

In palliative care, the intensity of breathlessness frequently worsens as death approaches. Patients and their families expect symptomatic relief of this devastating symptom.

Clinicians often respond by providing opioids, a highly effective treatment for this symptom but with a number of potentially undesirable side-effects, including excessive sedation.

Two RCTs in patients with advanced cancer have evaluated the efficacy of NIV in reducing dyspnoea.

HUIet al. [103] showed a similar improvement in dyspnoea scores between NIV and high-flow oxygen, while

A larger multicentre study [104] demonstrated a significantly greater reduction in breathlessness using NIV, especially in the hypercapnic subgroup of patients.

Interestingly, the latter investigation showed that NIV might reduce the dose of morphine necessary to palliate dyspnoea, maintaining better cognitive function.

Overall, NIV had a similar rate of acceptance by patients compared with oxygen therapy (~60%).

Recommendation

We suggest offering NIV to dyspnoeic patients for palliation in the setting of terminal cancer or other terminal conditions. (Conditional recommendation, moderate certainty of evidence.)

Should NIV be used in ARF due to chest trauma?

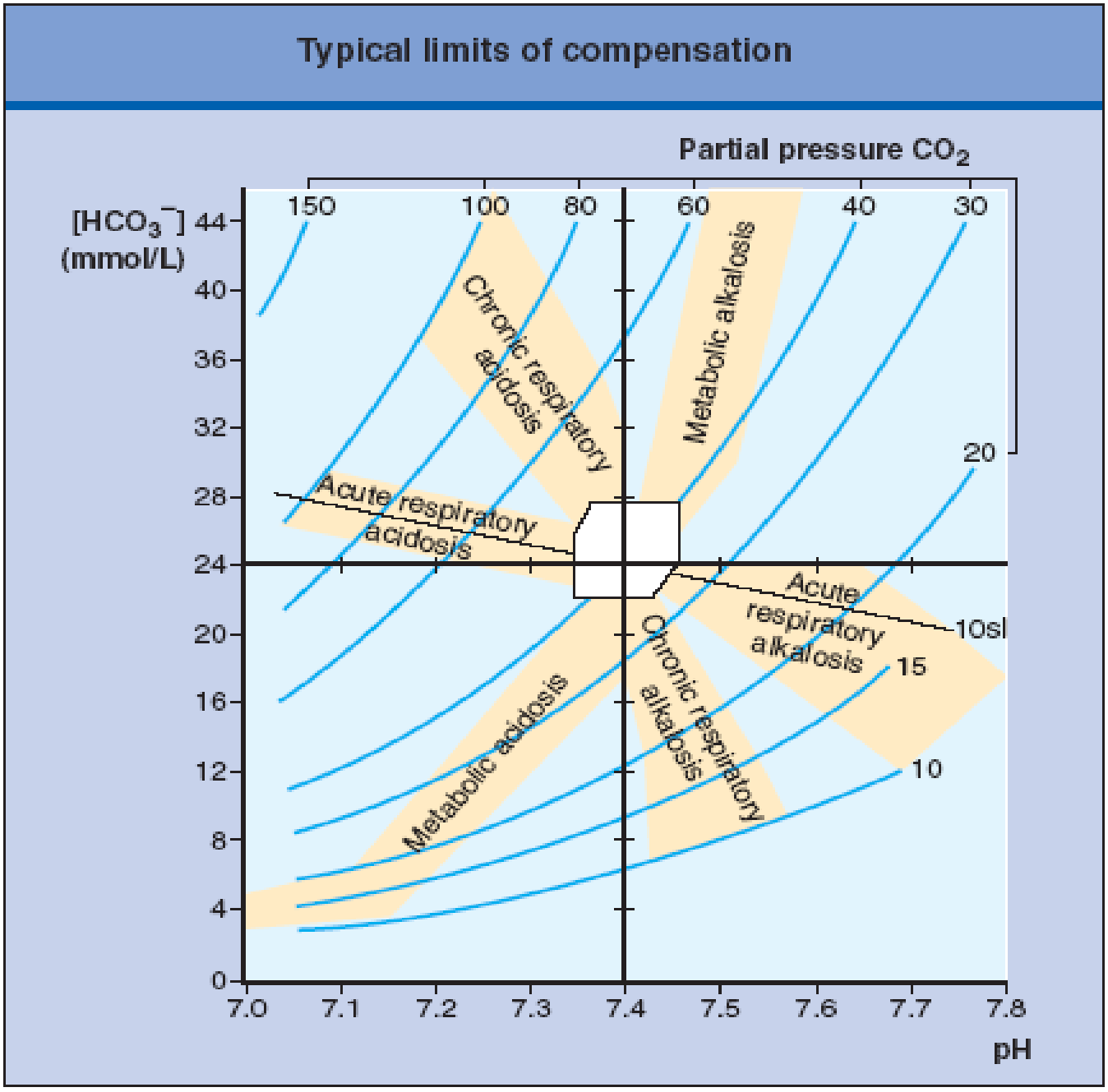
Pooled analysis demonstrated that NIV use led to a decrease

in mortality (RR 0.55,95% CI 0.22–1.41; moderate certainty),
the need for intubation (OR 0.21, 95% CI 0.06–0.74; moderate certainty)
the incidence of nosocomial pneumonia in this population.
(OR 0.29, 95% CI 0.13–0.64; low certainty)
a decrease in ICU length of stay (mean difference 2.47 lower, 95% CI 1.5–3.45 lower).

However, given the positive overall results, we suggest a cautious NIV trial in these patients when pain is controlled and hypoxaemia not severe.

Recommendation

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



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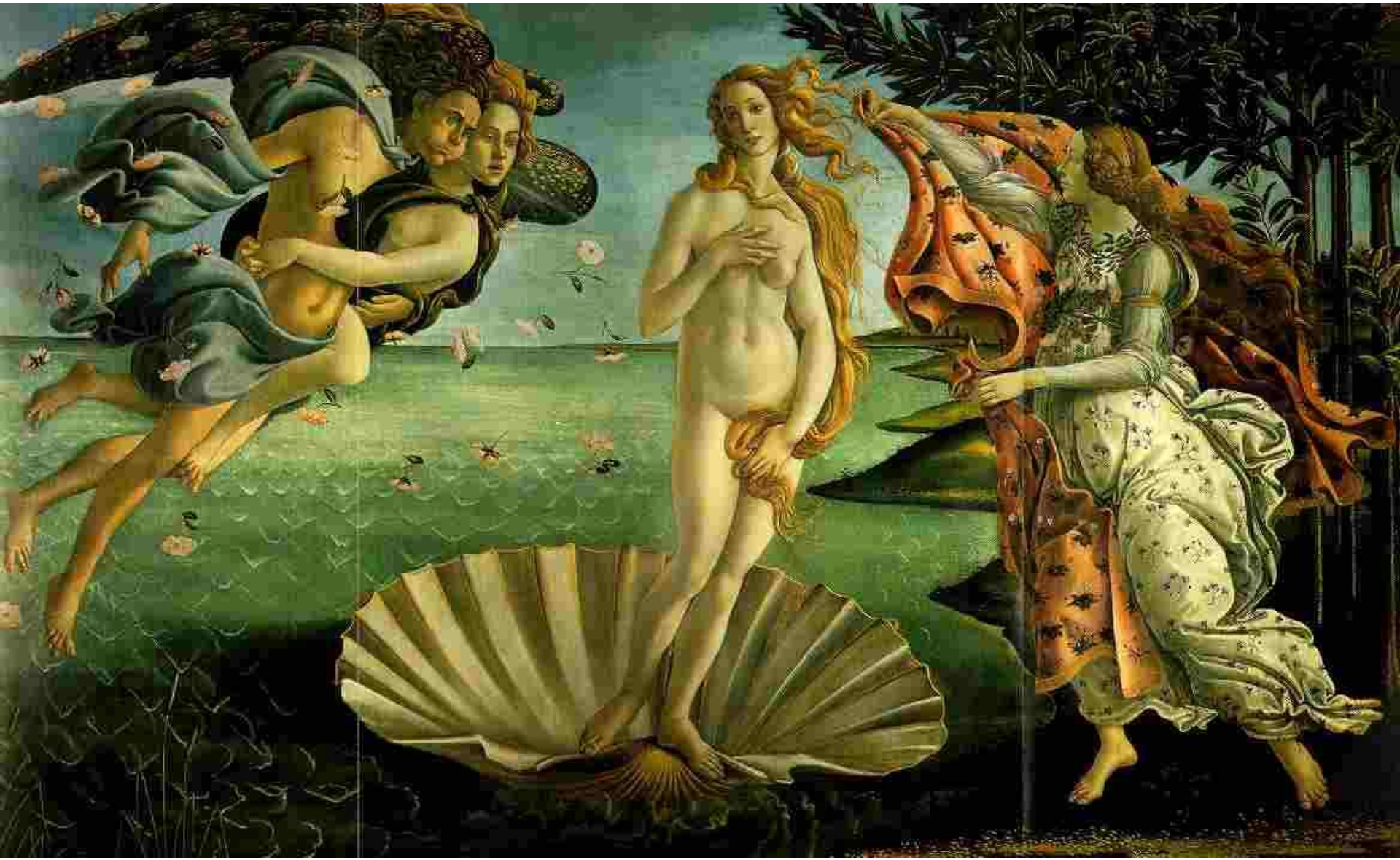


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