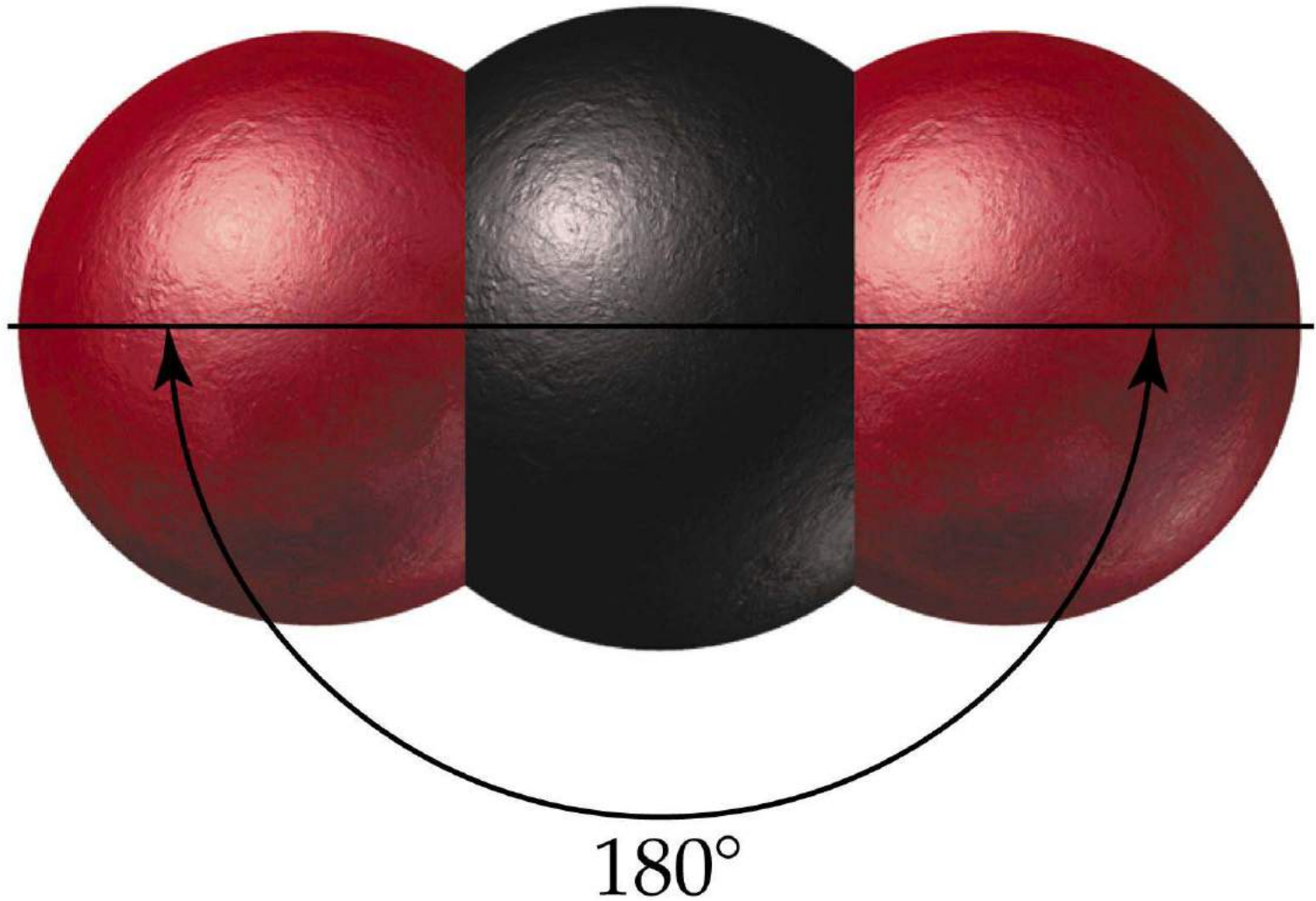


Akut Hiperkapnik Solunum Yetmezliğinde NIMV

Dr. Turgut TEKE

N.E. Üniversitesi Meram Tıp Fakültesi
Göğüs Hastalıkları ve Yoğun Bakım

Karbon Dioksid



Karbondioksitin Özellikleri

- Renksiz
- Kokusuz
- Yanmaz
- Yoğunluđu havanın ~1.5 katı



Karbondioksitin Kullanım Alanları

- Gazlı alkolsüz iecekler
- Soğutucular
- Yangın söndürücüler (özellikle su ile söndürülemeyen elektrik ve petrol yangınları)
- Gıda koruyucu
- Silahlar için itici
 - Paintball silahlarında



Hiperkapni ve Etkileri

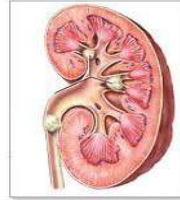
Hiperkapni: $\text{PaCO}_2 > 45 \text{ mm Hg}$

• Solunum Sistemi



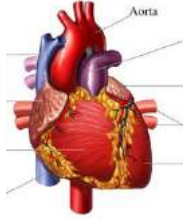
- PAO_2 de azalma
- OksiHb eğrisinde sağa kayma
- Diafragma fonksiyonlarında bozulma
- Pulmoner vazokonstrüksiyon

• Böbrekler



- Bikarbonat reabsorbsiyonunda artma

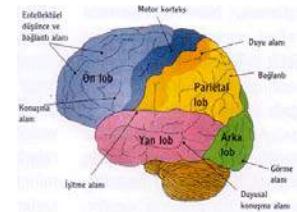
• Kardiyovasküler Sistem



- Kardiyak kontraktilitede azalma
- Sempatik stimülasyon
- Sistemik vasküler resistansın azalması

• Santral Sinir Sistemi

- Serebral vazodilatasyon
- İntrakraniyal basınç artması
- Bilinç bozukluğu



Hiperkapnik Solunum Yetmezliđi:

(Hiperkapni ve Asidoz Birlikteliđi)

Nöromusküler

“Medikal” Hastalıklar

Göğüs Duvarı

Hiperkapnik Solunum Yetmezliđi

Nöromusküler

- Beyin
 - İlaçlar
- Motor nöron
- Nöromusküler kavşak
- Solunum kasları

“Medikal” Hastalıklar

Göğüs Duvarı

Hiperkapnik Solunum Yetmezliđi

Nöromusküler

“Medikal” Hastalıklar

Göğüs Duvarı

- Kifoskolyoz
- Ankilozan Spondilit
- Yelken Göğüs

Hiperkapnik Solunum Yetmezliđi

Nöromusküler

“Medikal” Hastalıklar

- KOAH
- Şiddetli astım
- İleri evre interstisyel akciđer hastalıđı
- Pulmoner ödem
- OSAS / obezite-hipoventilasyon
- Hipotiroidizm

Göğüs Duvarı

Hiperkapnik Solunum Yetmezliđi

Nöromusküler

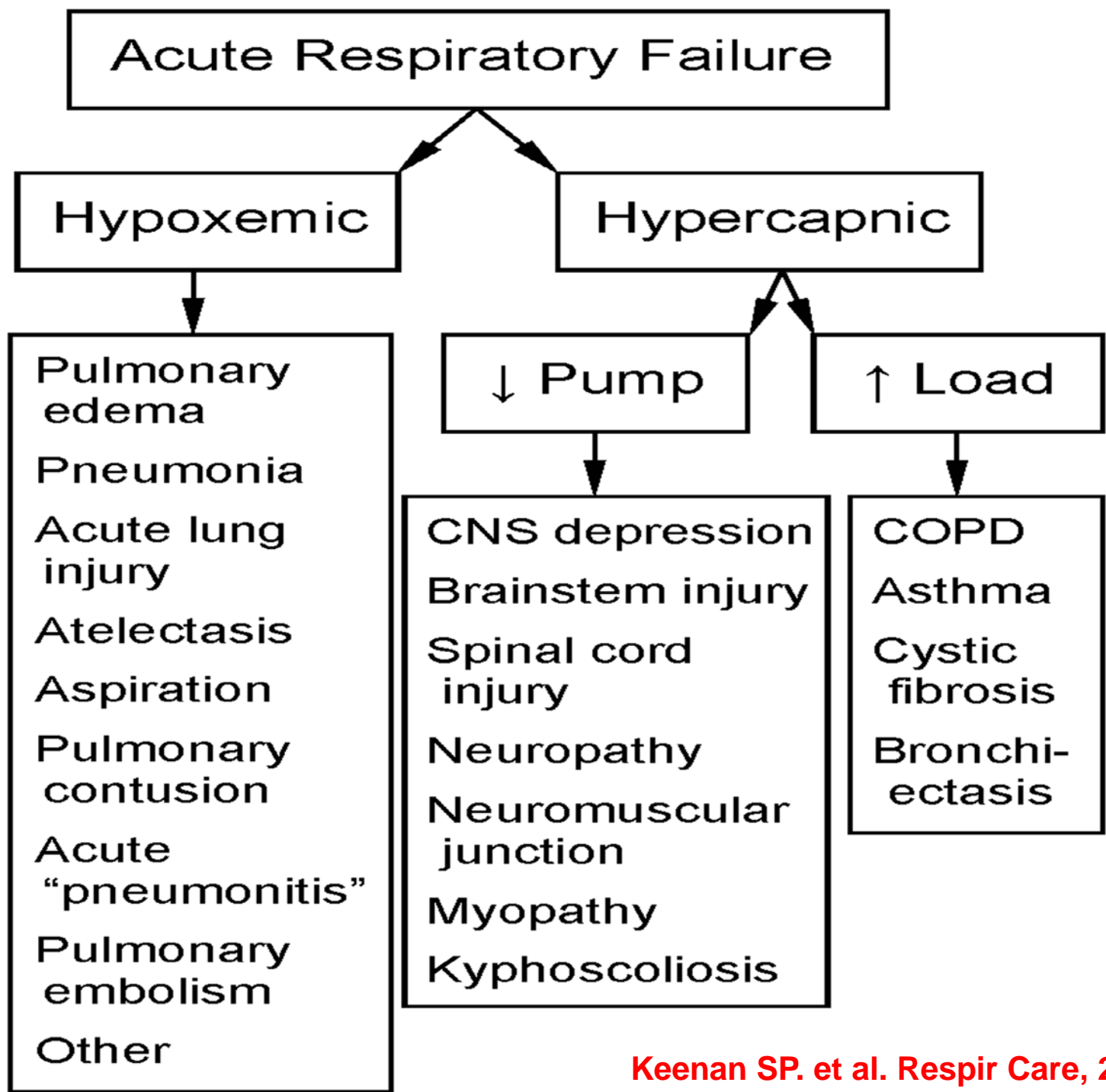
- Beyin
 - İlaçlar
- Motor nöron
- Nöromusküler kavşak
- Solunum kasları

Göğüs Duvarı

- Kifoskolyoz
- Ankilozan Spondilit
- Yelken Göğüs

“Medikal” Hastalıklar

- KOAH
- Şiddetli astım
- İleri evre interstisyel akciğeri hastalığı
- Pulmoner ödem
- OSAS / obezite-hipoventilasyon
- Hipotiroidizm



Hiperkapnik Solunum Yetmezliđi

Nöromusküler

- Beyin
 - İlaçlar
- Motor nöron
- Nöromusküler kavşak
- Solunum kasları

Göğüs Duvarı

- Kifoskolyoz
- Ankilozan Spondilit
- Yelken Göğüs

“Medikal” Hastalıklar

- KOAH
- Şiddetli astım
- İleri evre interstisyel akciğer hastalığı
- Pulmoner ödem
- OSAS / obezite-hipoventilasyon
- Hipotiroidizm

Hiperkapnik Solunum Yetmezliđi

Nöromusküler

- Motor nöron
- Nöromusküler kavşak
- Solunum kasları

Göğüs Duvarı

“Medikal” Hastalıklar

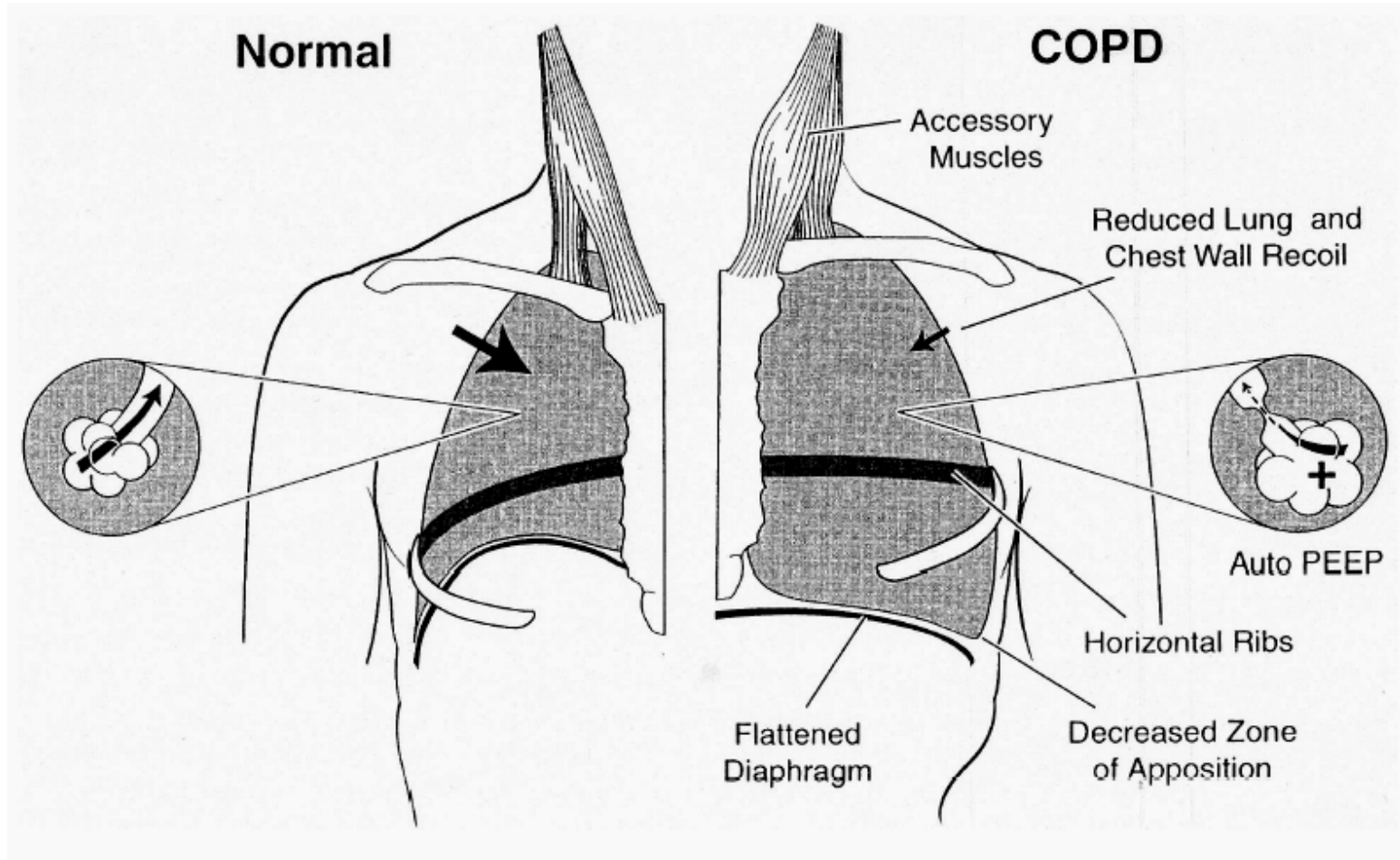
- **KOAH**
- **Şiddetli astım**
- İleri evre interstisyel akciğcr hastalığı
- OSAS / obezite-hipoventilasyon

Akut Solunum Yetmezliğinde NIMV

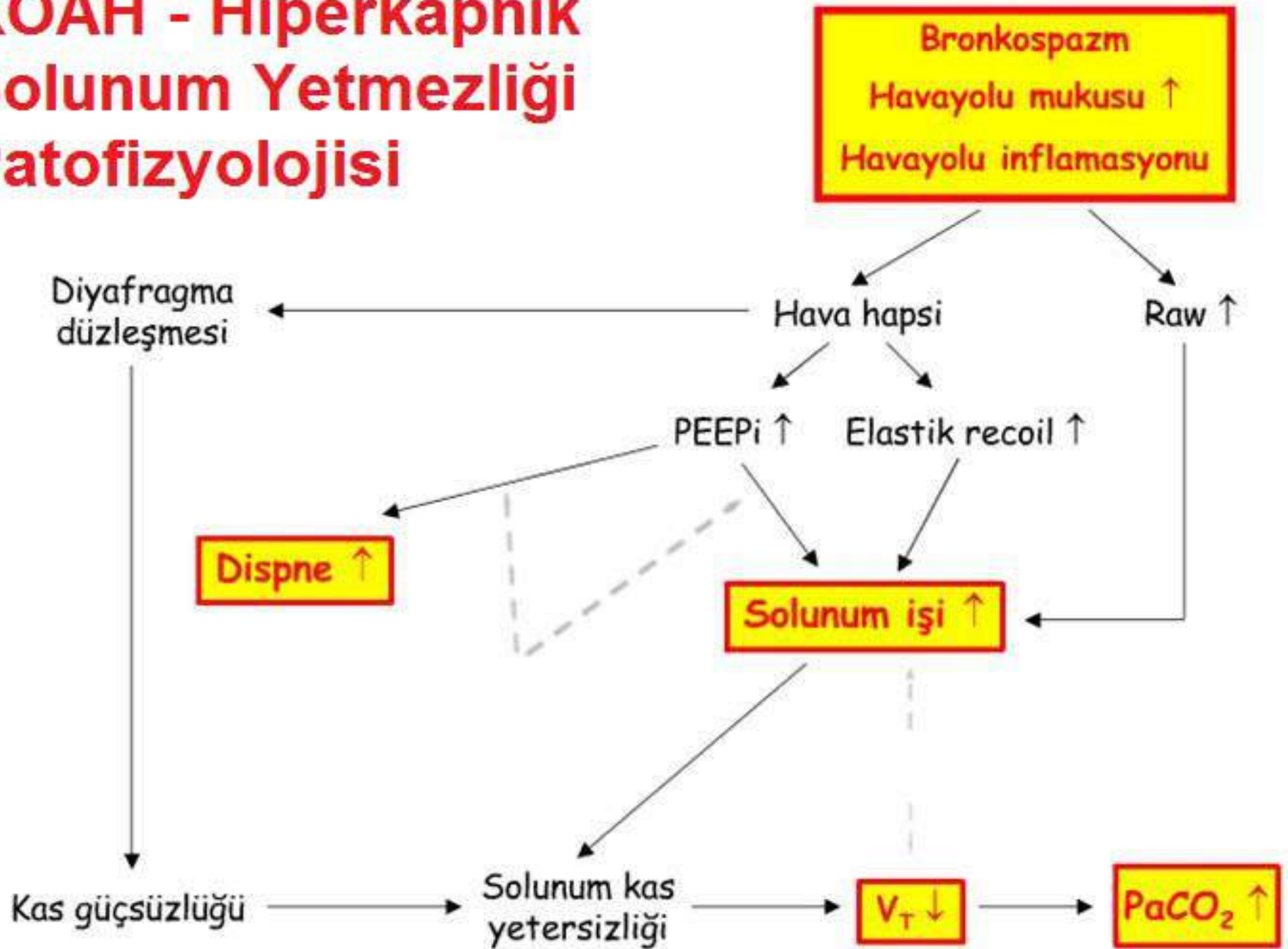
Etkinlik kanıtı	Hastalık
Kuvvetli (çok sayıda kontrollü çalışma)	KOAH Akut kardiyojenik pulmoner ödem (CPAP) İmmün düşkün hasta KOAH hastasında weaning'de
Orta derecede (tek kontrollü, birkaç vaka raporu)	Astma Kistik fibrozis Cerrahi sonrası solunum yetmezliği Ekstübasyon başarısızlığında Entübe edilmesi istenmeyen hastalarda
Zayıf delilleri olanlar (vaka raporları)	Üst havayolu obstrüksiyonlarında ARDS Travma hastaları OSA ve Obezite–hipoventilasyon sendromunda

Akut Hiperkapnik KOAHA Alevlenmesi - NIMV

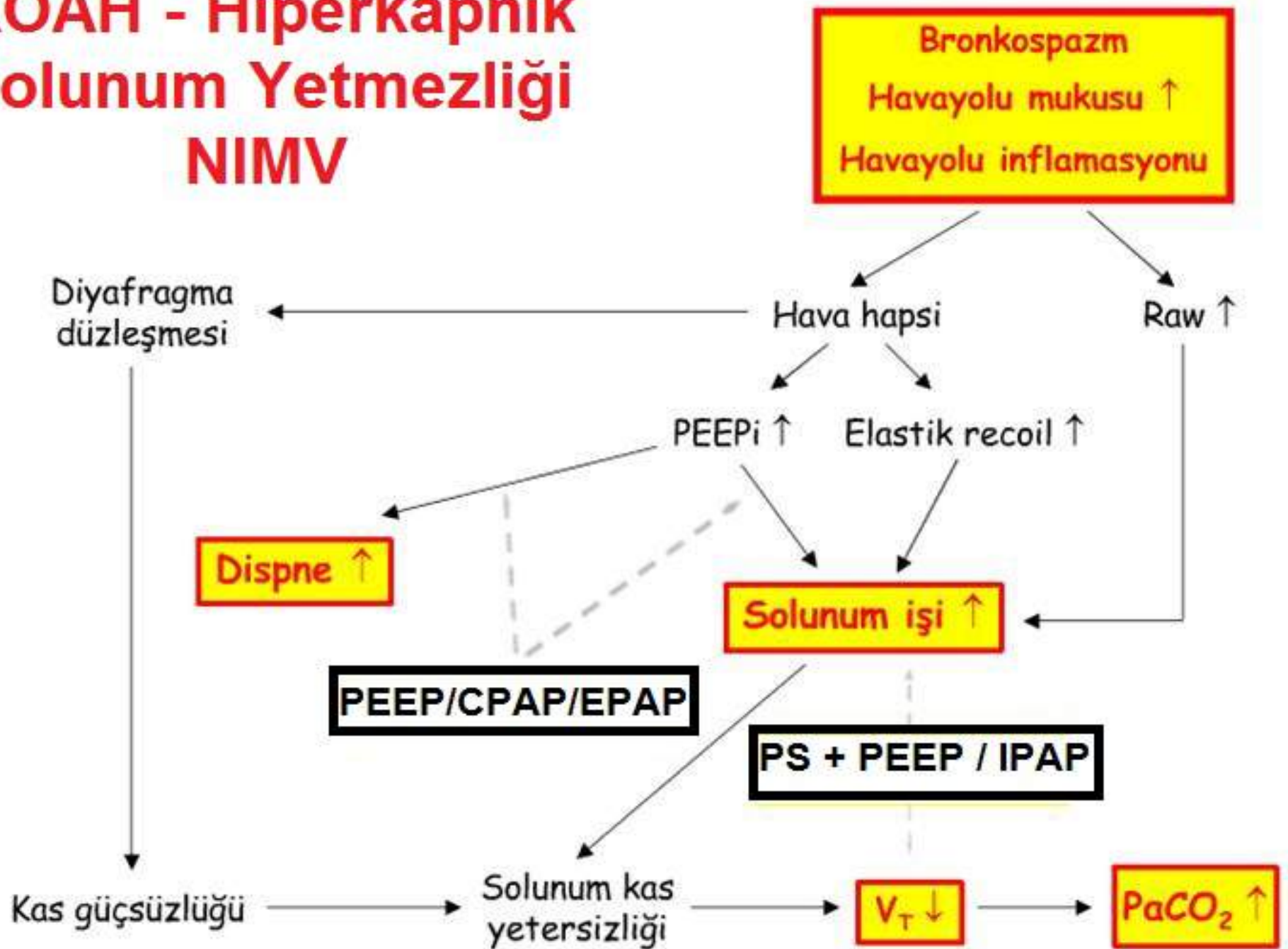
KOAH'da Solunum Mekanikliği



KOAH - Hiperkapnik Solunum Yetmezliği Patofizyolojisi



KOAH - Hiperkapnik Solunum Yetmezliđi NIMV



Control

Treatment

10

Airway pressure
(cmH₂O)

0

10

Transdiaphragmatic
pressure
(cmH₂O)

Unfiltered
diaphragmatic
EMG activity

1

0

Air flow
(L s⁻¹)

1 s



Mekanik Ventilasyonun Amaçları

- Pulmoner gaz değişimini düzeltmek
 - Hipoksemiyi düzeltmek
 - Respiratuar asidozu düzeltmek
- Solunum sıkıntısını azaltmak, dinlendirmek
 - Solunum çabasına bağlı oksijen tüketimini azaltmak
- Basınç - volüm ilişkilerini düzeltmek
 - Atelektaziyi önlemek ve tedavi etmek
 - Kompliyansı düzeltmek
 - Akciğer hasarının ilerlemesini önlemek
- Akciğerin iyileşmesine olanak sağlamak

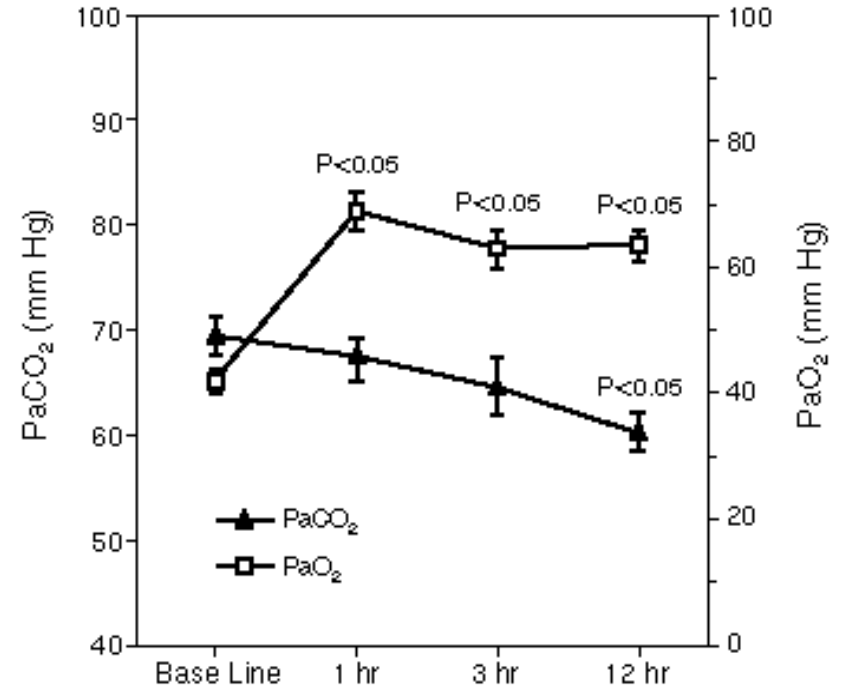
KOAH Alevlenmesi - NIMV

NONINVASIVE VENTILATION FOR ACUTE EXACERBATIONS OF CHRONIC OBSTRUCTIVE PULMONARY DISEASE

LAURENT BROCHARD, M.D., JORDI MANCEBO, M.D., MARC WYSOCKI, M.D., FRÉDÉRIC LOFASO, M.D.,
GIORGIO CONTI, M.D., ALAIN RAUSS, M.D., GÉRALD SIMONNEAU, M.D., SALVADOR BENITO, M.D.,
ALESSANDRO GASPARETTO, M.D., FRANÇOIS LEMAIRE, M.D., DANIEL ISABEY, PH.D., AND ALAIN HARF, M.D.

The NEW ENGLAND
JOURNAL of MEDICINE

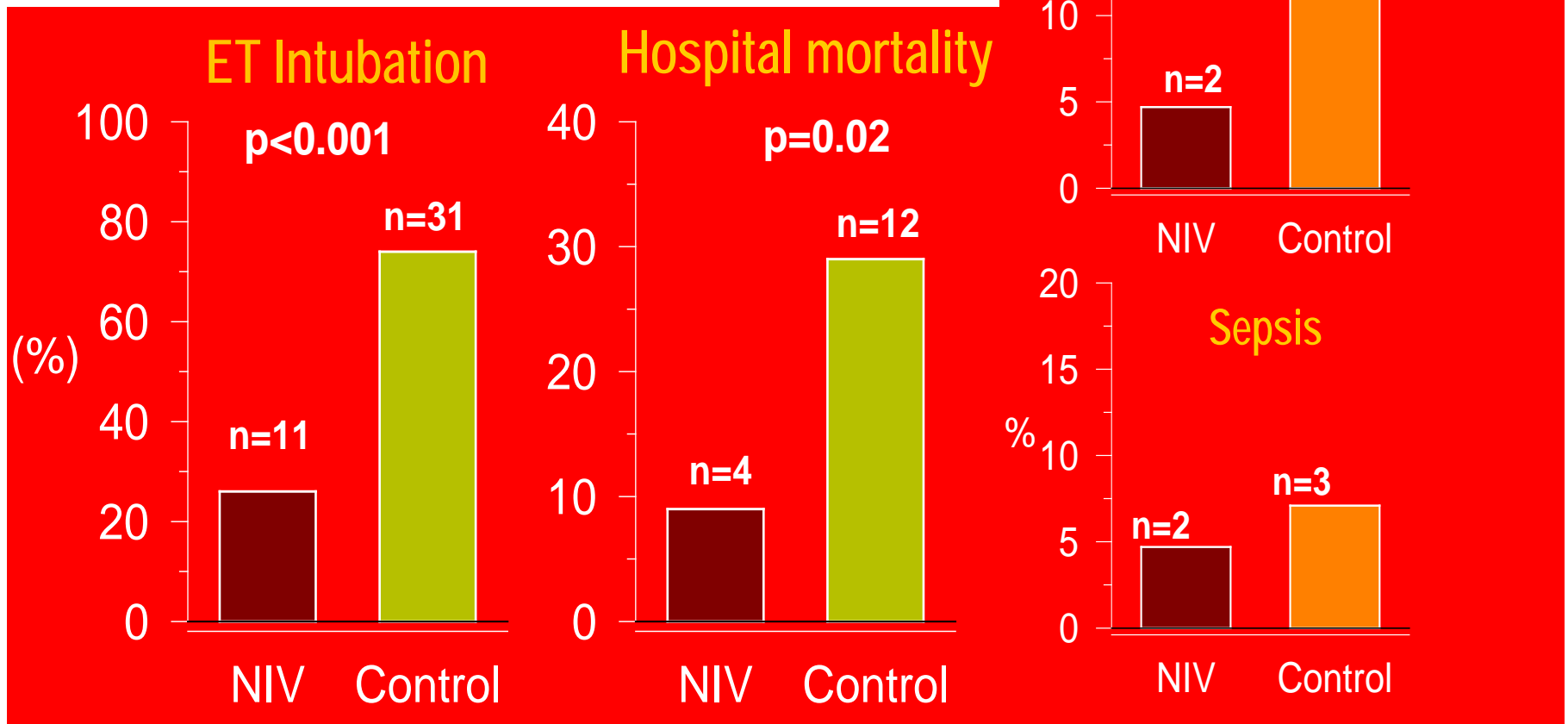
- Fransa, İtalya ve İspanya'dan 5 hastane
- Hiperkapnik KOAH alevlenmesi olan 85 hasta
- SMT karşı SMT + PSV
- NIMV PaCO₂ ve PaO₂ anlamlı olarak düzeltmiş



Brochard L. N Engl J Med, 1995

KOAH Alevlenmesi - NIMV

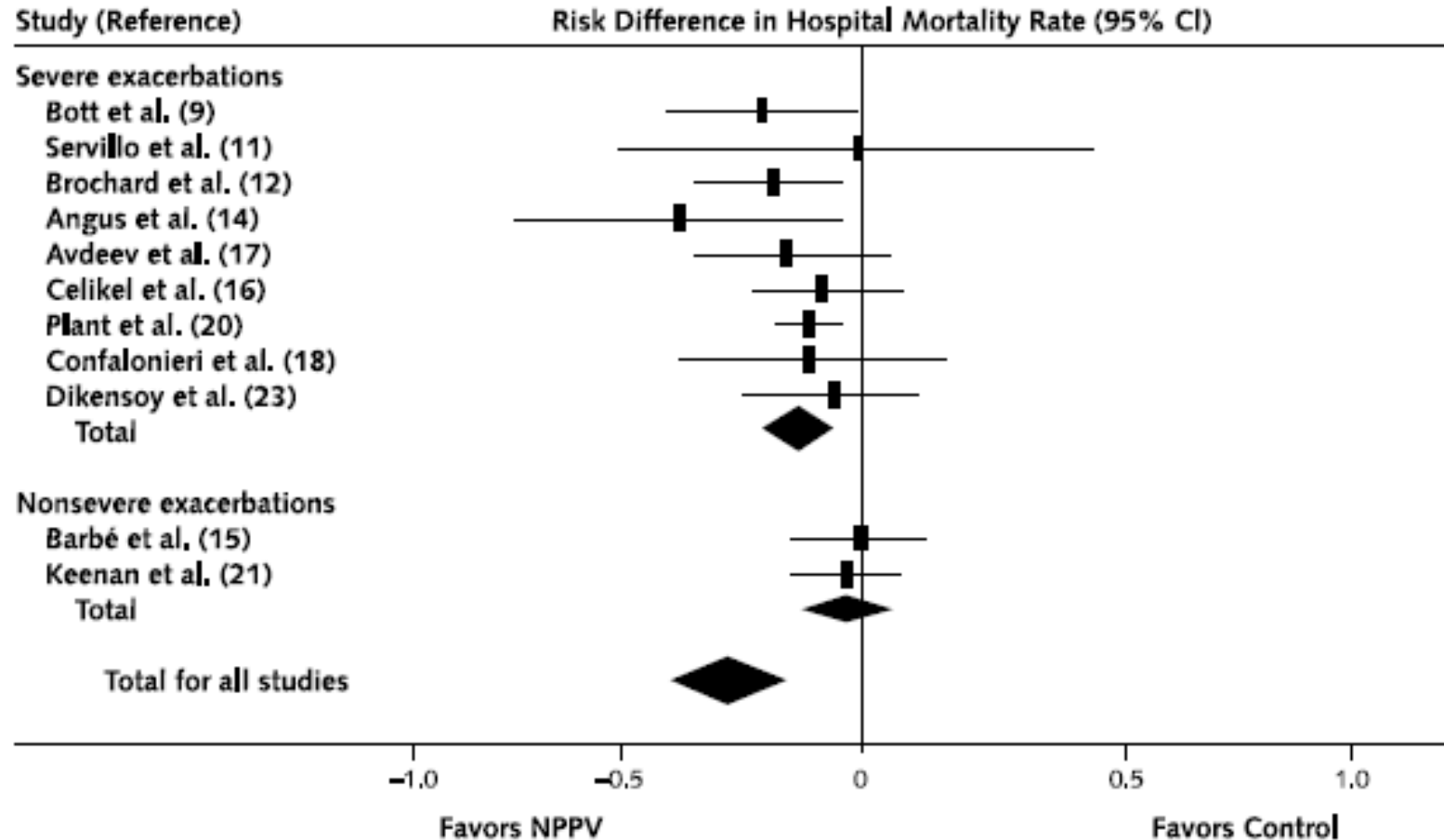
- KOAH + hiperkapnik solunum yetmezligi
- Standart tedavi vs PSV + standart tedavi



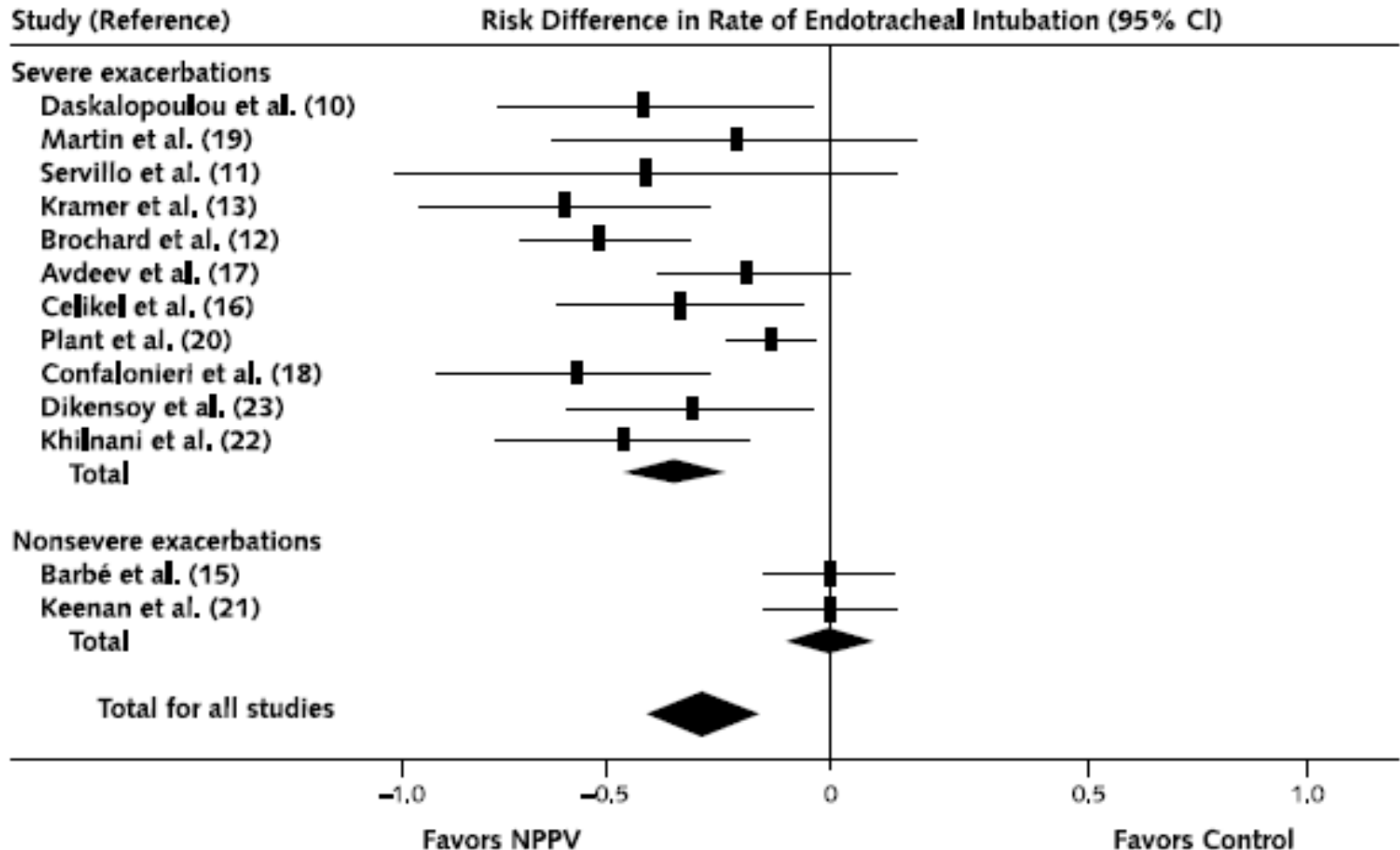
KOAH Alevlenmesi-NIMV

- Mortaliteyi azaltır → % 48
 - RR=0.52, %95 CI 0.35-0.76
- Entübasyon oranını azaltır → % 59
 - RR=0.41, %95 CI 0.33-0.53
- Hastanede kalma süresini azaltır → 3.24 gün
 - %95 CI -4.42 - -2.06

KOAH Alevlenmesi-NIMV



KOAH Alevlenmesi-NIMV



KOAH Alevlenmesi-NIMV

- Komplikasyon oranlarının azaltır
- Hastanede kalma süresini kısaltır
- Birinci saatte pH, PaCO₂ ve SS hızla düzeltir

Noninvasive Ventilation for Patients Presenting With Acute Respiratory Failure: The Randomized Controlled Trials

Sean P Keenan MD FRCPC MSc and Sangeeta Mehta MD FRCPC

- KOAH alevlenmesi (PaCO₂ > 45 mm Hg)
- 17 randomize kontrollü çalışma
- Standart Medikal Tedavi (SMT) ile SMT + NIMV karşılaştırılmış

Table 1. Randomized Controlled Trials of Noninvasive Ventilation for Acute Respiratory Failure, by Etiology

	RCTs (n)
Hypoxemic Acute Respiratory Failure	
Cardiopulmonary edema	Not covered in this review
ALI/ARDS	3 NIV 1 CPAP
Severe community-acquired or hospital-acquired pneumonia	2 NIV
Chest trauma	1 NIV 1 CPAP
Atelectasis	0
Acute on chronic respiratory disease (eg, interstitial lung disease)	0
Hypercapnic Acute Respiratory Failure	
Chronic obstructive pulmonary disease	17 NIV
Asthma	2 NIV
Neuromuscular	0
Primary central nervous system	0

RCT = randomized controlled trial
ALI = acute lung injury
ARDS = acute respiratory distress syndrome
NIV = noninvasive ventilation
CPAP = continuous positive airway pressure

Table 4. Summary of Evidence on Noninvasive Ventilation for Acute Respiratory Failure

Patient Population	Evidence	Intubation Benefit	Mortality Benefit	Possibility of Harm
Hypoxemic Respiratory Failure				
Acute lung injury/ARDS				
CPAP	1 RCT	No	No	Possible*
NIV	3 RCTs Small subgroups	Possible benefit for post-lung-resection patients Other patients: insufficient evidence	Possible benefit for post-lung-resection patients Other patients: insufficient evidence	Unclear†
Community-acquired pneumonia				
CPAP	No RCTs	Unclear	Unclear	Unclear
NIV	2 RCTs subgroups	Unclear: conflicting study results	Unclear: conflicting study results	Unclear
Chest Trauma				
CPAP	No RCTs‡	Unclear	Unclear	Unclear
NIV	No RCTs‡	Unclear	Unclear	Unclear
Hypercapnic Respiratory Failure				
COPD				
CPAP	No RCTs	Unclear	Unclear	Unclear
NIV	17 RCTs	Yes	Yes	Minimal§
Asthma				
CPAP	No RCTs	Unclear	Unclear	Unclear
NIV	2 RCTs	Unclear	Unclear	Unclear
Immunocompromised Patients				
CPAP	No RCTs	Unclear	Unclear	Unclear
NIV	2 RCTs	Probable	Probable	Unclear

* "Possible" implies some evidence in support.

† "Unclear" implies no evidence in support.

‡ The randomized controlled trials (RCTs) in patients with chest trauma (one study with continuous positive airway pressure [CPAP], one with noninvasive ventilation [NIV]) were not designed to test either intervention as a means of preventing intubation compared to epidural analgesia alone. Both CPAP and NIV appear to be better than intubating all patients with chest trauma.

§ "Minimal" implies that the evidence does not suggest harm other than pressure ulcers.

|| "Probable" implies supporting evidence but small numbers of trials and patients.

COPD = chronic obstructive pulmonary disease

International Consensus Conference :

Non-invasive ventilation in acute respiratory failure.

Int Care Med 2001;27;166-78

- **KOAH akut atađı** ile gelen ve hızla kliniđi kötüleşen hastalarda, gaz deđişiminin düzelmesi, solunum işinin azaltılması ve entübasyon ihtiyacının azaltılması için **NPPV mutlaka düşünölmeli. [A]**
- Hiperkapnik solunum yetmezliklerinde YB ve YB dışı hastalardaki karşılaştırma için RCT'lara ihtiyaç vardır.

GLOBAL STRATEGY FOR THE DIAGNOSIS, MANAGEMENT, AND PREVENTION OF CHRONIC OBSTRUCTIVE PULMONARY DISEASE

REVISED 2011



Noninvasive mechanical ventilation. Noninvasive intermittent ventilation (NIV) has been studied in several randomized controlled trials in acute respiratory failure, consistently providing positive results with success rates of 80-85%^{285,378-380}. These studies provide evidence that NIV improves respiratory acidosis (increases pH, and decreases PaCO₂), decreases respiratory rate, severity of breathlessness, and length of hospital stay (**Evidence A**). More importantly, mortality—or its surrogate, intubation rate—is reduced by this intervention³⁸⁰⁻³⁸³. However, NIV is not appropriate for all patients, as summarized in **Figure 5.4-8**²⁸⁵.

KOAH a Baęlı Akut Solunum Yetersizlięinde NIMV

Endikasyonlar

- Akut solunum sıkıntısına iřaret eden belirti ve bulgular (dispne, SS >24, yardımcı solunum kası kullanımı, paradoks solunum)
- Gaz alışverişinde anomali olması (PaCO₂ >45 mm Hg, pH <7.35 veya PaO₂/FiO₂ <200)

Kontrendikasyonlar

- Solunum Arresti
- Tıbbi instabilite
- Hava yolu açıklıęını koruyamama
- Ařırı sekresyon
- Ajitasyon ve uyumsuzluk
- Yüz travması, yanık, cerrahi, maskenin uymasını engelleyen anatomik anormallikler

NIMV Öncesi Başarı Belirteçleri

- Genç yaş (40 yaş üzeri x1.72)
- Düşük APACHE II skorları (>35 x1.81)
- Daha iyi nörolojik durum
- Daha az kaçak, dişlerin intakt olması
- Hiperkarbi olması, ancak çok aşırı değil (PaCO_2 > 45, < 90)
- Asidemi ancak çok aşırı değil (pH <7.35 and >7.10)

NIMV İşleminin Başarı Belirteçleri

- İlk 2 saat içerisindeki başlangıç cevabının iyi olması
 - pH da düzelme
 - PaCO₂ de düşme
 - SS da azalma
- Hastanın solunum eforunun ventilatör ile senkron olması
- Sekresyon miktarının az olması

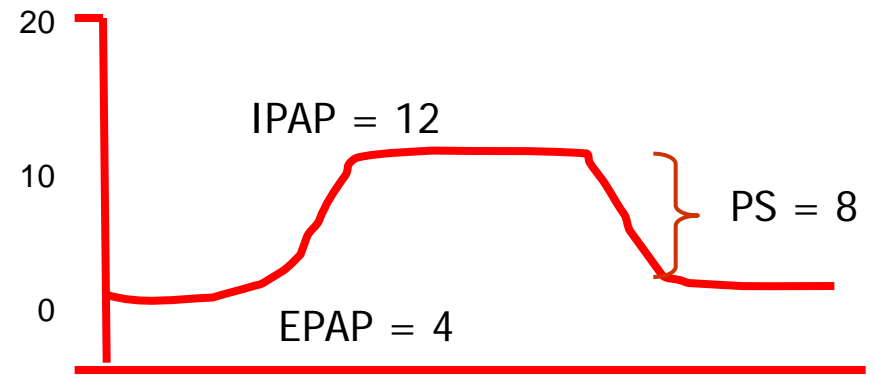
NIMV Uygulanması

- Hastanın ETI gerektirmediğinden emin ol
- Hastayı uygun bir şekilde gözlenilebilecek yerde tut (oksimetre-vital bulgu takibi)
- Hastayı bilgilendir-motive et
- Hasta yatağının başını 45⁰ kaldır
- Uygun maskeyi seç (tüm yüz maskesi)
- Önce maskeyi bağlamadan uygula
- İki parmak kuralı



Ventilatör Basınç Ayarları

- IPAP ayarı
 - 8-12 cm H₂O
 - Dakika ventilasyonu
- EPAP ayarı
 - 4-5 cm H₂O
 - Oksijenizasyon
- Aradaki fark PS
 - 7-16 cm H₂O

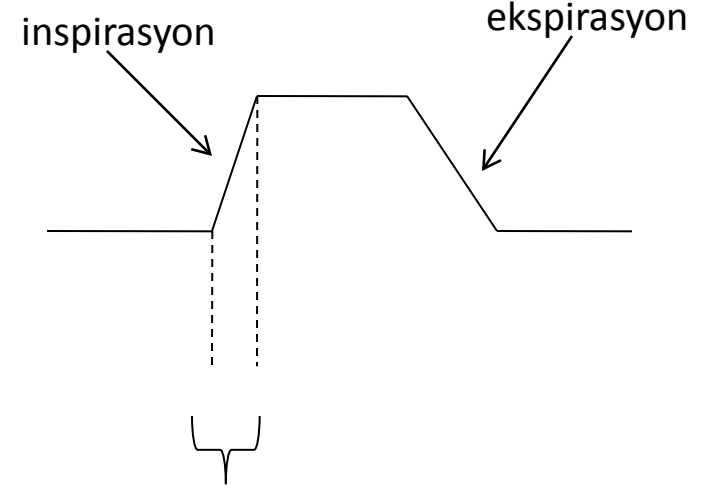


Basınçların Titrazyonu

- Hasta-ventilatör uyumu (senkronizasyon)
- Hasta konforu
- Kaçak durumu
- **IPAP titrazyonu**
 - Tidal volüm ve PaCO₂
 - İkişer ikişer arttırılarak
 - En iyi konfor ve en az dispne hissi
 - Aşırı IPAP → konforun bozulması
- **EPAP titrazyonu**
 - Oksijenizasyon
 - Birer birer arttırılarak
 - Aşırı EPAP → Kaçak ve intolerans
 - EPAP arttırılırken IPAP arttırılmazsa inspiratuar destek azalır

Diğer Ayarlar

- **Rise Time**
 - Hedeflenen basınca ulaşma zamanı
 - Konforu artırır
 - KOAH da 0.05-0.1 sn gibi hızlı
 - Nöromusküler hast. da 0.3-0.5 sn gibi uzun
- **Rampa Zamanı**
 - Ayarlanan IPAP basıncına ulaşma zamanı
 - 5-45 dk
- **Backup Solunum Sayısı**
 - Apne
 - 12-24
 - Spontan solunumdan az (2/3)

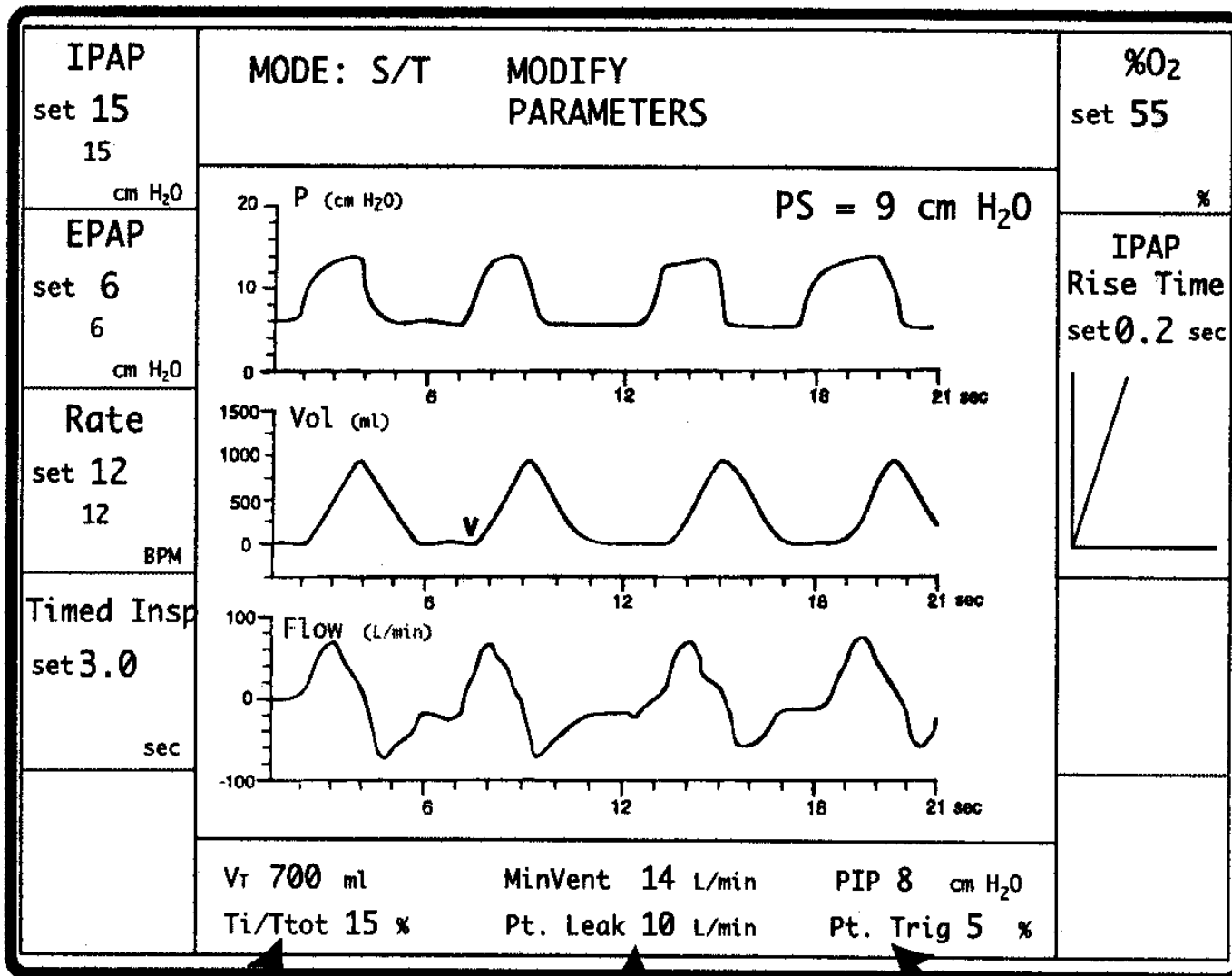


Oksijen

- FiO_2 oksijen saturationu > % 90 olacak şekilde
- Blender yok ise maske veya proksimal uca T-konnektör
- Ciddi hipoksemi var ise O_2 blenderi olan ventilatör

Monitorizasyon

- Hasta konforu ve uyumu
- Ventilasyon senkronizasyonu
- Peak inspiratuar basınç <30 cm H₂O
 - Kaçak
 - Hava aspirasyonu
- Maskenin uygunluğu/cildin durumu/kaçak
 - Ventilatörlerin çoğu kaçağı kompanze eder
 - Cilt tahrişini engellemek için bağlar hafifçe gevşetilerek küçük kaçaklara müsaade edilebilir



Inspiratory Time/
Total Cycle Time

Patient Leak

Percentage of
Patient-Triggered
Breaths

ASTIM ATAK - NIMV

Astım Atak - NIMV

- Karmaşık
 - Hasta karakteristikleri farklı (Hipoksemik-Hiperkapnik)
 - NIMV uygulama yerleri ve ekip farklı (Acil servis –YBÜ – Solunumsal YBÜ)
- NIMV entübasyonu engelliyor mu ???
- 10 dan fazla çalışma
- Randomize kontrollü çalışma az (3 tane)
- Deneyim kısıtlı.....

Astım Atak - NIMV

Table 4. Summary of Evidence on Noninvasive Ventilation for Acute Respiratory Failure

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|| "Probable" implies supporting evidence but small numbers of trials and patients.

COPD = chronic obstructive pulmonary disease

Noninvasive Positive Pressure Ventilation in Status Asthmaticus*

*Gianfranco U. Meduri, MD, FCCP; Timothy R. Cook, MD;
Robert E. Turner, RRT; Mark Cohen, MD; and
Kenneth V. Leeper, MD, FCCP*

- Meduri ve ark. (1996 yılında)
- 3 yıllık dönemde
- 17 hiperkapnik astım atağında NIMV deneyimi
- Basınç ayarları
 - CPAP: 4 ± 2 cm H₂O (IPAP: 4)
 - PS: $14,5 \pm 5$ cm H₂O (EPAP: 18)
- Amaç:
 - SS'nı 25/dk altına çekmek
- Sonuç:
 - Hiperkapnik SY olan astım ataklarında NIMV düşük basınçlarda kan gazlarını düzeltmede oldukça etkili

Astım Atak - NIMV

Parameter*	NPPV
No. of episodes	17
Age, yr	35±11
Female/male	10/7
Recent use of corticosteroids	6
Duration of symptoms, h	94±97
Mean BP, mm Hg	116±23
HR, beats/min	121±17
RR, breaths/min	29±5
Dyspnea score [†]	4±1
Silent chest on auscultation [†]	3
Accessory muscle use [†]	11
pH	7.25±.07
PaCO ₂ , mm Hg	65±11
PaO ₂ : FIO ₂	311±154
APACHE II score	14±4
Predicted mortality [§]	12±11
Prior episode of ARF	8

Correction of hypercarbia [†]	15
Duration of MV, h	16±21
Sedation during MV [†]	2
Complications [§]	0
Duration of ICU stay, h	51±73
Duration of hospital stay, d	5±4

Astım Atak - NIMV

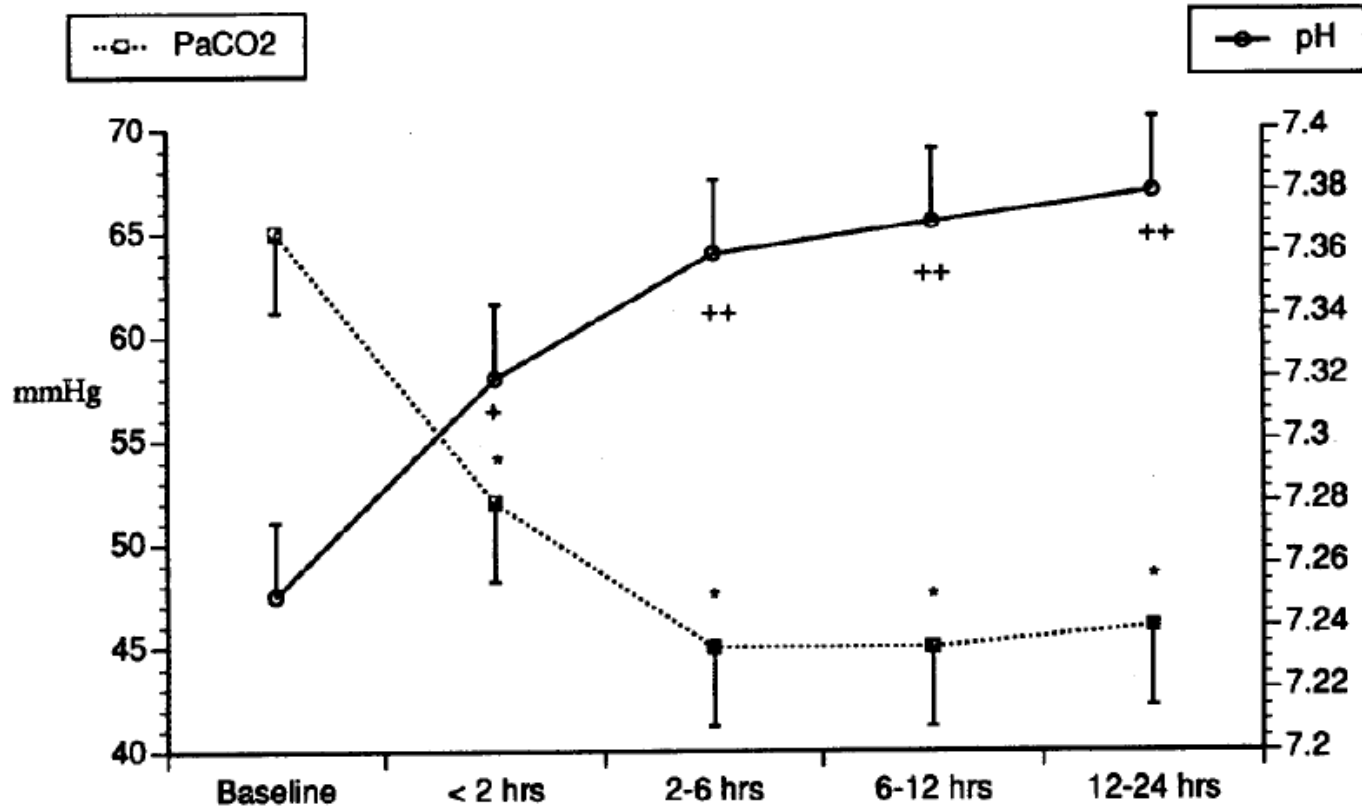


FIGURE 1. PaCO₂ and pH response in NPPV-treated patients. Plus sign indicates p=0.0012; two plus signs, p<0.001; asterisk, p=0.002.

Astım Atak - NIMV

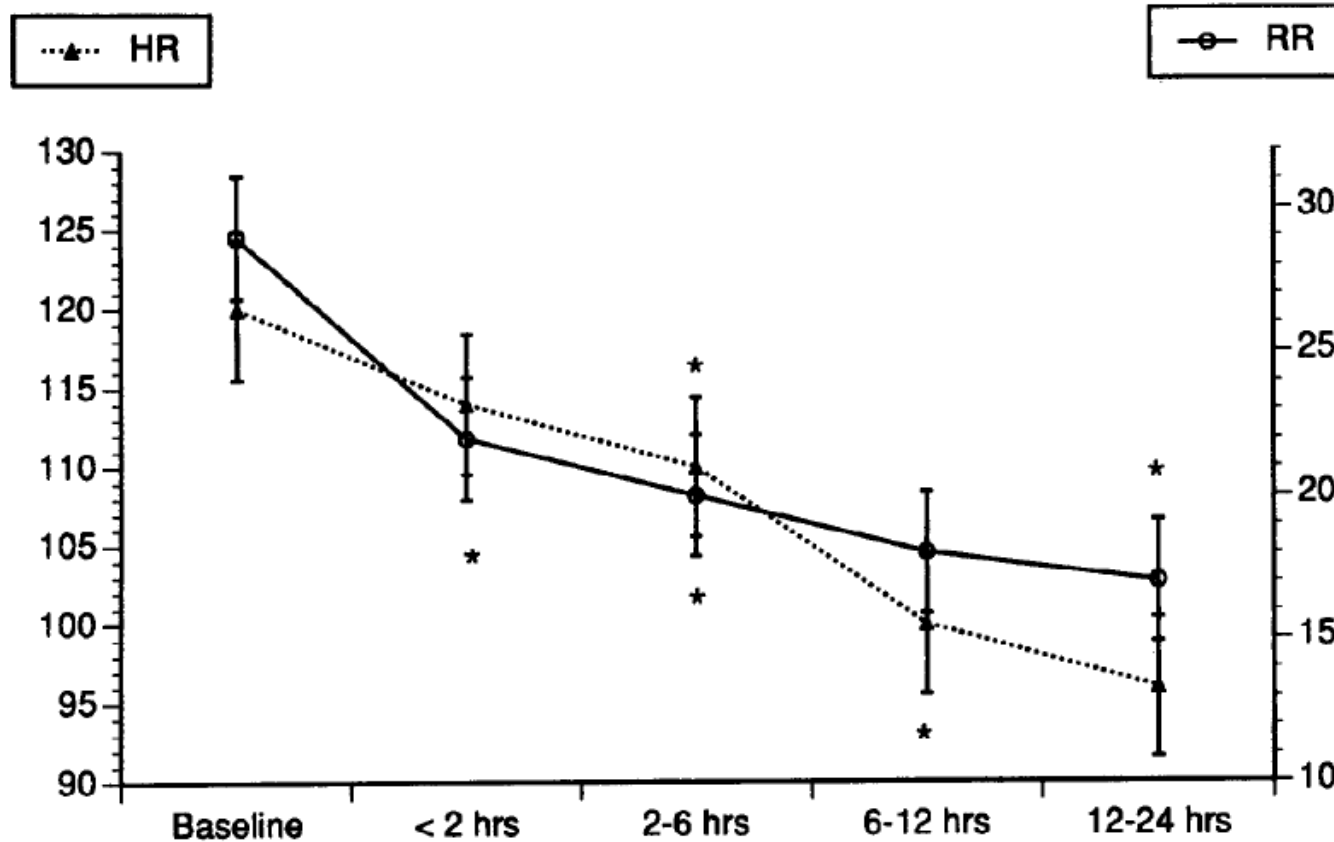


FIGURE 2. RR and HR response in NPPV-treated patients. Asterisk(*)=p<0.0001.

A Pilot Prospective, Randomized, Placebo-Controlled Trial of Bilevel Positive Airway Pressure in Acute Asthmatic Attack*

Arie Soroksky, MD; David Stav, MD; and Isaac Shpirer, MD

- PRKÇ
- Acil servis
- 30 hasta
 - 15 → NIMV + Medikal
 - 15 → Medikal
- NIMV SFT değerlerini anlamlı şekilde düzeltmiş
- NIMV hastaneye yatma ihtiyacını azaltmış

Table 1—Demographic and Physiologic Parameters on Hospital Admission*

Parameters	BPV Group	Control Group	p Value
Patients, No.	15	15	
Age, yr	34.07 ± 8.55	32.53 ± 9.68	NS
Female/male gender, No.	8/7	7/8	
Mean FEV ₁ , % predicted†	37.27 ± 10.69	33.8 ± 10.18	NS
Mean FEV ₁ , L	1.26 ± 0.39	1.16 ± 0.35	NS
Mean FVC, % predicted†	48.27 ± 11.87	48.6 ± 16.05	NS
Mean FVC, L	1.94 ± 0.56	1.94 ± 0.65	NS
Mean PEFR, % predicted†	38 ± 11.95	34 ± 11.2	NS
Duration of attack, d	2.6 ± 2.13	2.07 ± 1.71	NS
Duration of asthma, yr	12.13 ± 9.81	10.27 ± 6.33	NS
pH	7.41 ± 0.04	7.40 ± 0.02	NS
P _a CO ₂ , mm Hg	33.59 ± 3.48	34.29 ± 5.41	NS
P _a O ₂ , mm Hg	82.85 ± 38.72	85.82 ± 29.6	NS
Hemoglobin, g/dL	14.08 ± 2.47	14.41 ± 2.87	NS
Heart rate, beats/min	120.8 ± 19.21	109.33 ± 12.02	NS
Mean BP, mm Hg	97.32 ± 6.87	99.3 ± 8.67	NS
Respiratory rate, breaths/min	34.8 ± 1.82	33.53 ± 1.73	NS
Permanent use of inhaled corticosteroids‡	8	6	NS
Permanent use of inhaled β-agonists‡	14	13	NS
Permanent use of systemic corticosteroids‡	2	1	NS
Prior episodes of acute respiratory failure§	2	0	NS

Soroksky A. et al. Chest, 2003

Astım Atak - NIMV

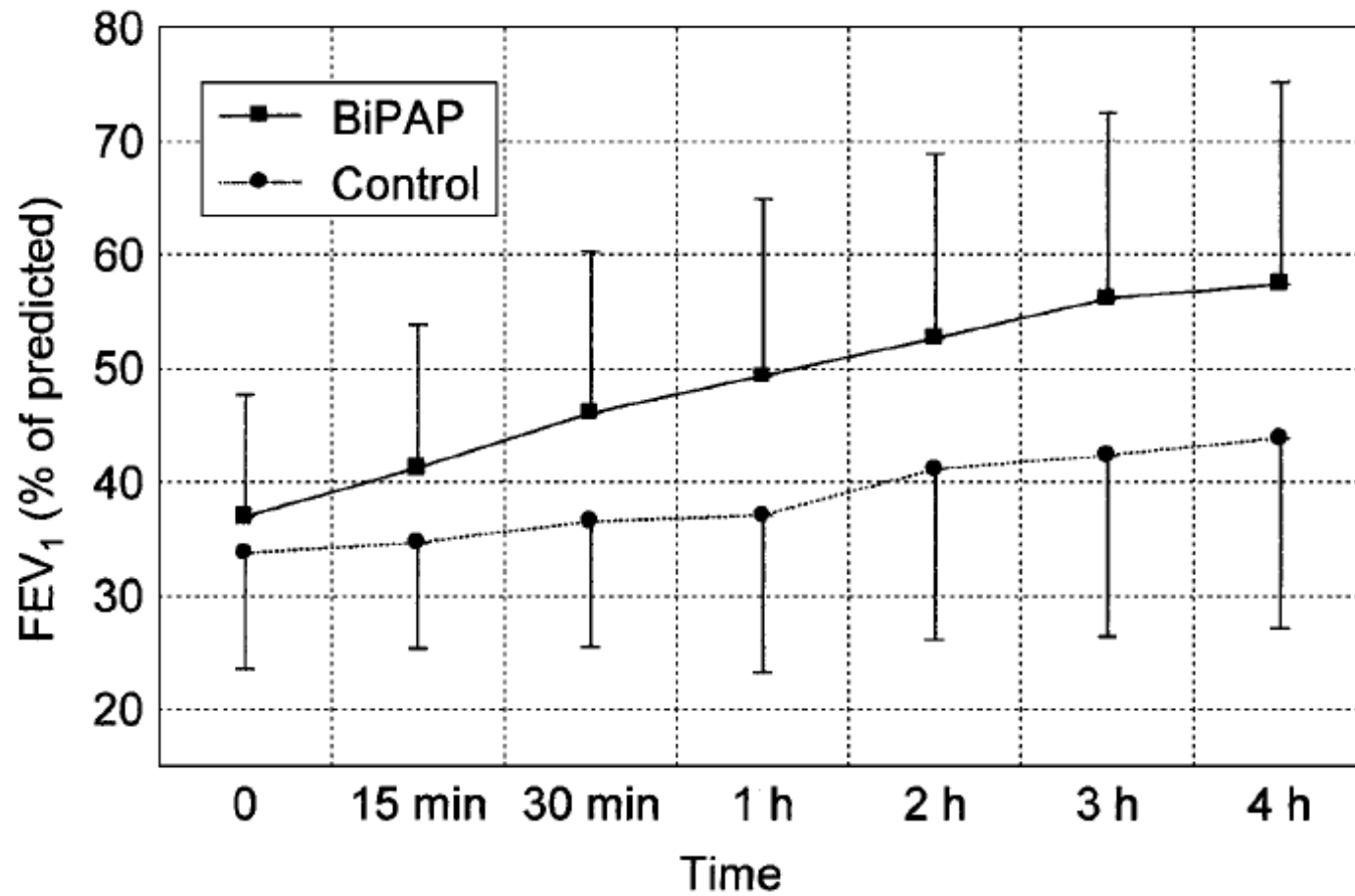
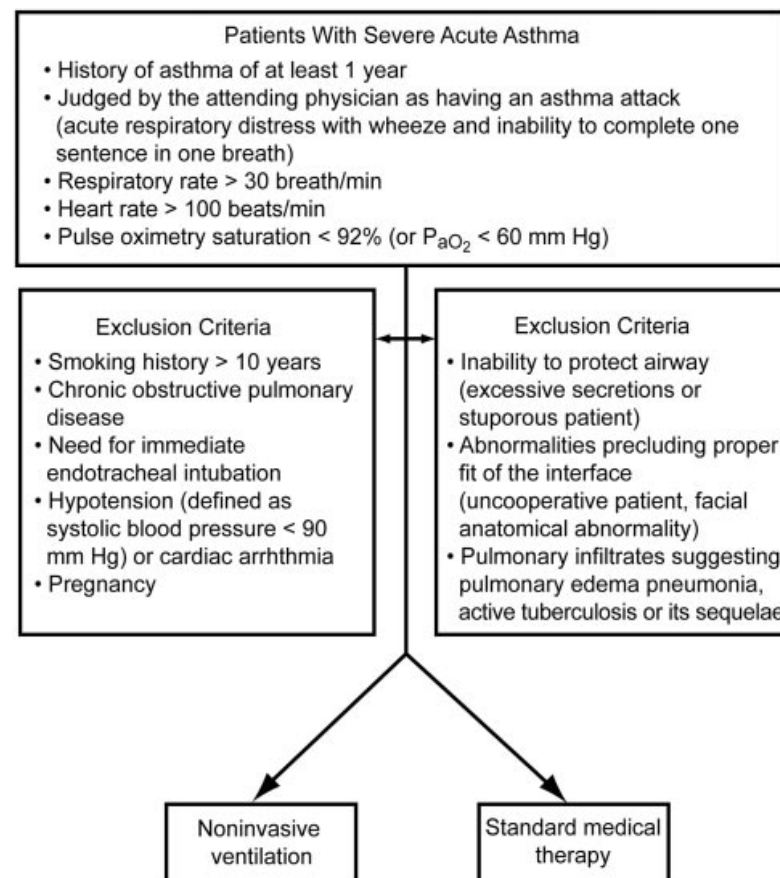


FIGURE 2. Change in FEV₁ in BPV group (BiPAP) and control group during 4 h.

A Prospective Randomized Controlled Trial on the Efficacy of Noninvasive Ventilation in Severe Acute Asthma

Dheeraj Gupta MD DM, Alok Nath MD DM, Ritesh Agarwal MD DM,
and Digamber Behera MD

- En az bir yıldır astım
- SS > 30
- Nabız > 100
- Hipoksemik
- 53 şiddetli astım atak hastası
 - 25 SMT
 - 28 SMT + NIMV
- Ortalama basınçlar
 - EPAP: 5 cm H₂O
 - IPAP: 12 cm H₂O



A Prospective Randomized Controlled Trial on the Efficacy of Noninvasive Ventilation in Severe Acute Asthma

Table 1. Baseline Characteristics

	Standard Medical Treatment (<i>n</i> = 25)	NIV (<i>n</i> = 28)	All Subjects (<i>n</i> = 53)	<i>P</i>
Age (mean ± SD y)	41.6 ± 12.5	46.2 ± 16.2	44.1 ± 14.6	.26
Female (<i>n</i> , %)	20 (80)	22 (78.6)	42 (79.2)	.91
Body mass index (mean ± SD kg/m ²)	24.3 ± 4.3	22.9 ± 3.3	23.6 ± 3.8	.19
Duration of asthma (median and IQR y)	6 (4–10)	10 (3.5–20)	8 (4–15)	.03
Duration of exacerbation (mean ± SD d)	3.2 ± 2.2	3.4 ± 2.2	3.3 ± 2.2	.91
Respiratory rate (median and IQR breaths/min)	38 (32–42)	36 (32–40)	36 (32–41)	.60
Heart rate (mean ± SD beats/min)	117.1 ± 13.7	120.7 ± 12.8	119 ± 13.3	.58
Systolic blood pressure (median and IQR mm Hg)	140 (126–165)	130 (124.5–140)	130 (126–150)	.09
Diastolic blood pressure (median and IQR mm Hg)	90 (80–98)	84 (80–90)	86 (80–90)	.26
Pulsus paradoxus (mean ± SD mm Hg)	21.9 ± 11.1	19.6 ± 5.3	20.7 ± 8.5	.33
FEV ₁ (mean ± SD L)	0.56 ± 0.3	0.48 ± 0.2	0.51 ± 0.3	.25
FEV ₁ (mean ± SD % predicted)	24.4 ± 12.3	21.6 ± 10.3	22.9 ± 11.3	.67
pH (mean ± SD)	7.43 ± 0.04	7.42 ± 0.06	7.43 ± 0.05	.70
P _{aO₂} /F _{IO₂} (mean ± SD mm Hg)	298 ± 63	281 ± 65	289 ± 64	.33
P _{aCO₂} (mean ± SD mm Hg)	35.1 ± 8.8	37 ± 7.9	36.1 ± 8.3	.41
Number of GINA criteria (median and IQR)*	8 (7–9)	8 (8–9)	8 (7–9)	.64

* The Global Initiative for Asthma (GINA) criteria are: breathlessness at rest, can speak only in short sentences, respiratory rate > 30 breaths/min, use of accessory muscles of respiration, loud wheeze, heart rate > 120 beats/minute, pulsus paradoxus > 25 mm Hg, peak expiratory flow < 60% of predicted or < 100 L/min, P_{aO₂} < 60 mm Hg.

IQR = interquartile range

FEV₁ = forced expiratory volume in the first second

F_{IO₂} = fraction of inspired oxygen

A Prospective Randomized Controlled Trial on the Efficacy of Noninvasive Ventilation in Severe Acute Asthma

OBJECTIVE: Evaluate the efficacy of NIV in severe acute asthma. **METHODS:** Patients with severe acute asthma were randomized to receive either standard medical therapy or NIV in addition to medical therapy. The primary outcomes were improvement in forced expiratory volume in the first second (FEV_1), intensive care unit (ICU) stay, and hospital stay. The secondary outcomes were rate of improvement in respiratory rate, blood pH, ratio of P_{aO_2} to fraction of inspired oxygen (F_{IO_2}), P_{aCO_2} , requirement for inhaled medications, and failure of primary therapy. **RESULTS:** Fifty-three patients with severe acute asthma (42 females and 11 males, mean \pm SD age 44 ± 15 y, $FEV_1 < 30\%$ of predicted) were randomized to NIV ($n = 28$) or standard medical therapy ($n = 25$). The baseline variables were similar in the 2 groups except for the mean duration of asthma, which was shorter in the standard-medical-therapy group. The median inspiratory and expiratory airway pressures applied were 12 cm H_2O and 5 cm H_2O , respectively. There was a significant improvement in respiratory rate, FEV_1 , and P_{aO_2}/F_{IO_2} (but not pH or P_{aCO_2}) in both the groups, but no significant difference between the 2 groups. The number of patients who had a $\geq 50\%$ improvement in FEV_1 at 1, 2, and 4 hours was nonsignificantly greater in the NIV arm. ICU and hospital stay was significantly shorter in the NIV group. The mean dose of inhaled bronchodilator was significantly less in the NIV group. There were 4 instances of standard-medical-therapy failure, and all those patients improved with NIV. Two patients in the NIV arm required invasive ventilation. There was no mortality in either of the arms. **CONCLUSION:** In patients with severe acute asthma, the addition of NIV to standard medical therapy probably accelerates the improvement in lung function, decreases the inhaled bronchodilator requirement, and shortens the ICU and hospital stay, but a larger study is required to settle this issue. (Clinicaltrials.gov registration NCT00510991.) *Key*

ASTIM ATAKTA NIMV:

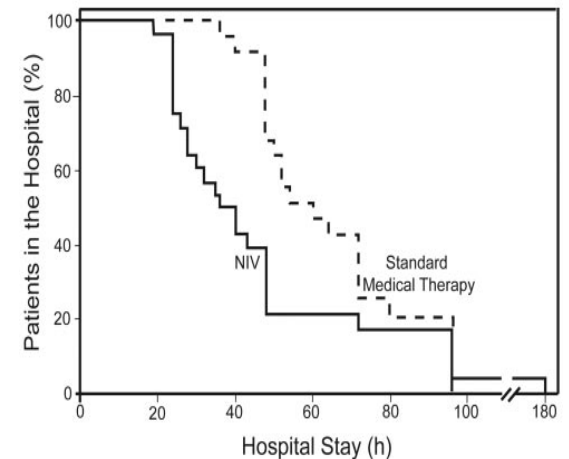
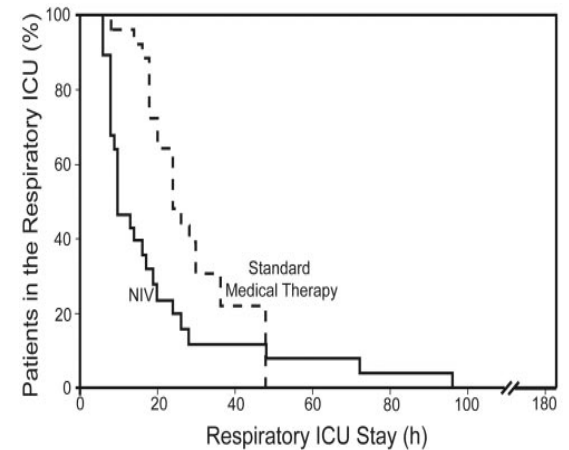
- Solunum fonksiyonlarındaki iyileşmeyi hızlandırır
- İnhalasyon bronkodilatör ihtiyacını azaltır
- YBÜ ve Hastanede yatış sürelerini kısaltır

A Prospective Randomized Controlled Trial on the Efficacy of Noninvasive Ventilation in Severe Acute Asthma

Table 3. Outcomes

	Standard Medical Therapy (n = 25)	NIV (n = 28)	P
Primary Outcomes			
≥ 50% improvement in FEV ₁ over baseline (n, %)			
At 1 h	11 (44)	10 (36)	.62
At 2 h	12 (48)	15 (54)	.70
At 4 h	16 (64)	24 (86)	.08
ICU stay (median and IQR h)	24 (18–36)	10 (8–20)	.01
Hospital stay (median and IQR h)	54 (48–72)	38 (24–48)	.01
Secondary Outcomes			
Time to disappearance of accessory muscle use (mean ± SD h)	3.2 ± 1.7	2.3 ± 1.4	.06
Dose of inhaled salbutamol (mean ± SD mg)	42.8 ± 10.4	31.2 ± 14.5	.008
Dose of inhaled ipratropium (mean ± SD mg)	7.6 ± 2.2	5.2 ± 2.8	.007
Failure of primary therapy (n, %)	4 (16)	2 (7)	.35

FEV₁ = forced expiratory volume in the first second
IQR = interquartile range



Astım Atak - NIMV



Non-invasive positive pressure ventilation for treatment of respiratory failure due to severe acute exacerbations of asthma

Ram FSF, Wellington SR, Rowe BH, Wedzicha JA

Published Online: October 7, 2009

Non-invasive positive pressure ventilation (NPPV) enhances breathing in acute respiratory conditions by resting fatigued breathing muscles. It has the advantage that it can be applied intermittently for short periods, which may be sufficient to reverse the breathing problems experienced by patients during severe acute asthma. This review was undertaken to determine the effectiveness of NPPV in patients with severe acute asthma. Only one trial could be included in the review; however, compared to usual medical care alone NPPV reduced hospitalisations, increased the number of patients discharged from the emergency department, and improved respiratory rate and lung function measurements. The application of NPPV in patients suffering from status asthmaticus, despite some promising preliminary results, still remains controversial. Further studies are needed to determine the role of NPPV in the management of severe acute asthma.

- Bazı ilginç ve ümit verici sonuçlar var
 - Hastane yatışını azaltır
 - Solunum sayısını düzeltir
 - Solunum fonksiyonlarını iyileştirir
- Ancak Astımda NIMV uygulaması hala tartışmalı...
- Yeni RCT'lara ihtiyaç var

Diğer Akut Hiperkapnik Durumlar - NIMV

Bronşektazi - NIMV

- **Bronşektazi** akut atağına bağlı respiratuvar asidozu ($\text{pH} < 7.35$) olan hastalarda NIMV denenebilir, fakat sekresyonların fazlalığı etkinliğini azaltabilir. Rutin olarak kullanılmamalı. **[C]**

BTS rehberi

İleri Evre İnterstisyel Akciğer Hastalığı - NIMV

- İPF akut alevlenmesi sırasında gelişen solunum yetmezliğinde NIMV kullanımı ile ilgili birkaç veri mevcut

Al-Hameed FM ve ark. Can Respir J, 2004

Saydain G ve ark. AJRCCM, 2001

İleri Evre İnterstisyel Akciğer Hastalığı - NIMV

INTERNAL  MEDICINE

□ ORIGINAL ARTICLE □

Noninvasive Ventilation in Acute Exacerbation of Idiopathic Pulmonary Fibrosis

Toshiki Yokoyama¹, Yasuhiro Kondoh², Hiroyuki Taniguchi², Kensuke Kataoka², Keisuke Kato², Osamu Nishiyama², Tomoki Kimura², Ryuichi Hasegawa³ and Keishi Kubo¹

(Inter Med 49: 1509-1514, 2010)

(DOI: 10.2169/internalmedicine.49.3222)

İleri Evre İnterstisyel Akciğer Hastalığı - NIMV

Abstract

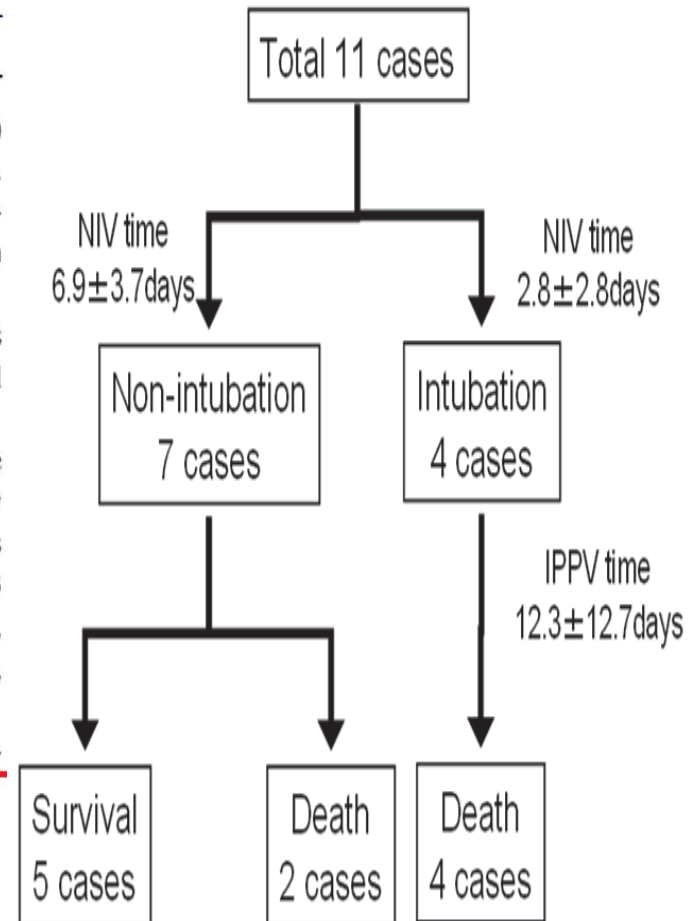
Background and Objective The outcome of acute exacerbation of idiopathic pulmonary fibrosis (AE-IPF) is usually very poor, and it has been suggested that mechanical ventilation does not benefit AE-IPF patients. Noninvasive ventilation (NIV) has attracted attention as a means to avoid intubation in acute respiratory failure, including acute respiratory distress syndrome (ARDS). This study describes the outcome of patients with AE-IPF who were treated with NIV.

Methods Patients included in the study were those who fulfilled the criteria for AE-IPF during the periods between April 1998 and June 2004 at Tosei General Hospital, and in whom NIV was introduced. Clinical data were obtained retrospectively from patient records.

Results This study included 11 patients. The initial NIV settings were continuous positive airway pressure (CPAP) mode in 6 patients (mean 10.1 ± 2.5 cmH₂O) and Spontaneous/Timed mode in 5 (mean inspiratory positive airway pressure/expiratory positive airway pressure; $15.0 \pm 3.3/10.2 \pm 2.9$ cmH₂O). Five patients avoided intubation and survived more than 3 months after AE-IPF. Six patients who failed NIV died within 3 months. In these 6 patients, 4 required intubation. The other 2 patients, who refused endotracheal intubation, died without intubation. Median survival time and 3-month survivals after acute exacerbation were 30 days, and 45.5%, respectively.

Conclusion Considering extremely poor prognosis of AE-IPF, our findings suggest that NIV is a viable option for the respiratory management in AE-IPF, and should be studied in a large, well-controlled trial.

Key words: ARDS, interstitial lung disease, idiopathic pulmonary fibrosis, ventilation, acute exacerbation of idiopathic pulmonary fibrosis



İleri Evre İnterstisyel Akciğer Hastalığı - NIMV

Table 3. Respiratory Management for AE-IPF

	All cases n=11	Survivors n=5	Non-survivors n=6	p-value
Total duration of NIV (days)	5.4±3.8	8.4±2.9	2.8±2.1	NS
mode (CPAP / ST mode)	6/5	3/2	3/3	NS
CPAP (cmH ₂ O)	10.0±2.5	8.0±0.0	12.0±2.0	NS
ST IPAP (cmH ₂ O)	15.0±3.3	14.0±2.8	15.7±4.0	NS
EPAP (cmH ₂ O)	10.2±2.91	9.0±1.4	11.0±3.6	NS
Duration from introduction of NIV to start of steroid therapy (days)	2.2±1.2	2.2±1.6	2.3±0.8	NS

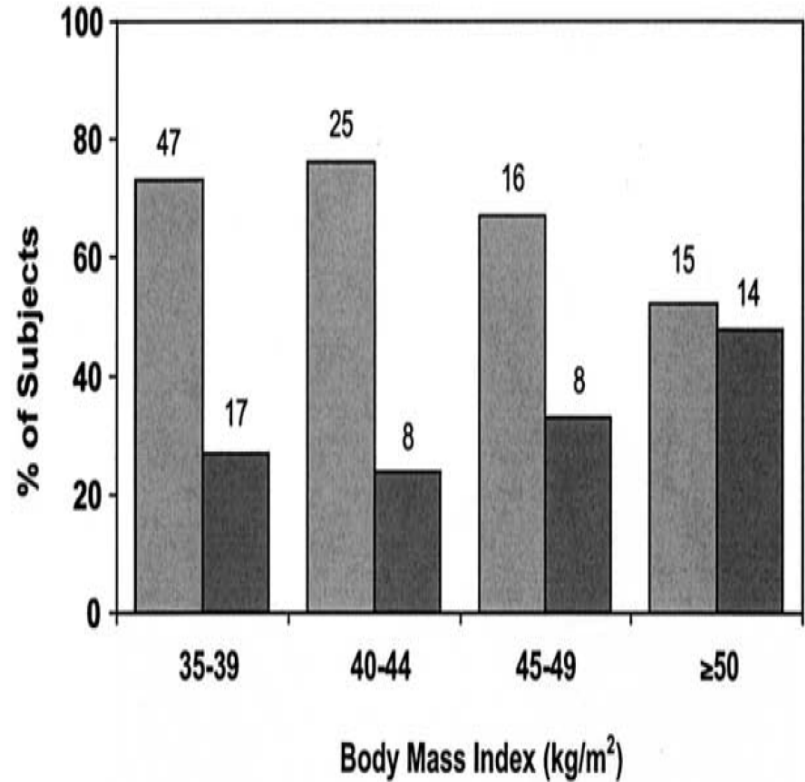
*NS: Not Significant, p > 0.05, p < 0.05, p < 0.001

Obezite Hipoventilasyon Sendromu (OHS) - NIMV

- Tanım
 - BMI > 30 kg/m²
 - Uyanıkken PaCO₂ > 45 mm Hg
 - Hiperkapninin başka bir nedene bağlı olmaması

Obezite Hipoventilasyon Sendromu (OHS) - NIMV

- Hospitalize edilen hastalarda OHS
- Dahili bölümlere yatan 4332 hasta
- 277 (%6) hasta şiddetli obez (BMI > 35 kg/m²)
- OHS prevalansı şiddetli obez hastalarda % 31
 - OHS olanlarda PaCO₂: 52 ± 7 mm Hg
 - Basit obezitesi olanlarda PaCO₂: 37 ± 6 mm Hg
- BMI > 50 kg/m² olanlarda OHS prevalansı % 48



Koyu barlar OHS,
Açık barlar basit obezite

Non-invasive Ventilation in Acute Hypercapnic Respiratory Failure due to Obesity-Hypoventilation Syndrome and COPD.

Carrillo A, Ferrer M, Gonzalez-Diaz G, Lopez-Martinez A, Llamas N, Alcazar M, Capilla L, Torres A.

ICU, Hospital Morales Meseguer, Murcia, Spain.

Abstract

BACKGROUND: Non-invasive ventilation (NIV) is widely used in episodes of acute hypercapnic respiratory failure (AHRF) in chronic obstructive pulmonary disease (COPD) patients. However, there is no evidence on the efficacy of NIV during similar episodes in obesity-hypoventilation syndrome (OHS). We therefore compared the efficacy of NIV in episodes of AHRF due to OHS and COPD.

METHODS: We prospectively assessed 716 consecutive patients (173 with OHS and 543 with COPD) with AHRF (arterial pH <7.35 and PaCO₂ >45 mmHg) treated with a similar protocol of NIV. We defined successful NIV as avoidance of intubation and ICU survival at least 24 hours in the ward. Hospital survivors were followed for 1 year to assess hospital readmission and survival.

RESULTS: Both groups had similar (mean±SD) baseline respiratory acidosis (arterial pH, 7.22±0.08; PaCO₂, 86±21 mmHg). Patients with OHS were older (74±11 vs. 71±10 years, p<0.001), were more frequently female (134, 77% vs. 66, 12%, p<0.001), had less late NIV failure (12, 7% vs. 67, 13%, p=0.037), lower hospital mortality (10, 6% vs. 96, 18%, p<0.001) and higher one-year survival (odds-ratio 1.83, 95% confidence interval 1.24-2.69, p=0.002). However, survival adjusted for confounders (adjusted odds-ratio 1.41, 95% confidence interval 0.70-2.83, p=0.34), NIV failure (11, 6% vs. 59, 11%, p=0.11), length of stay and hospital readmission were similar in both groups. Among COPD patients, obesity was associated with less late NIV failure and hospital readmission.

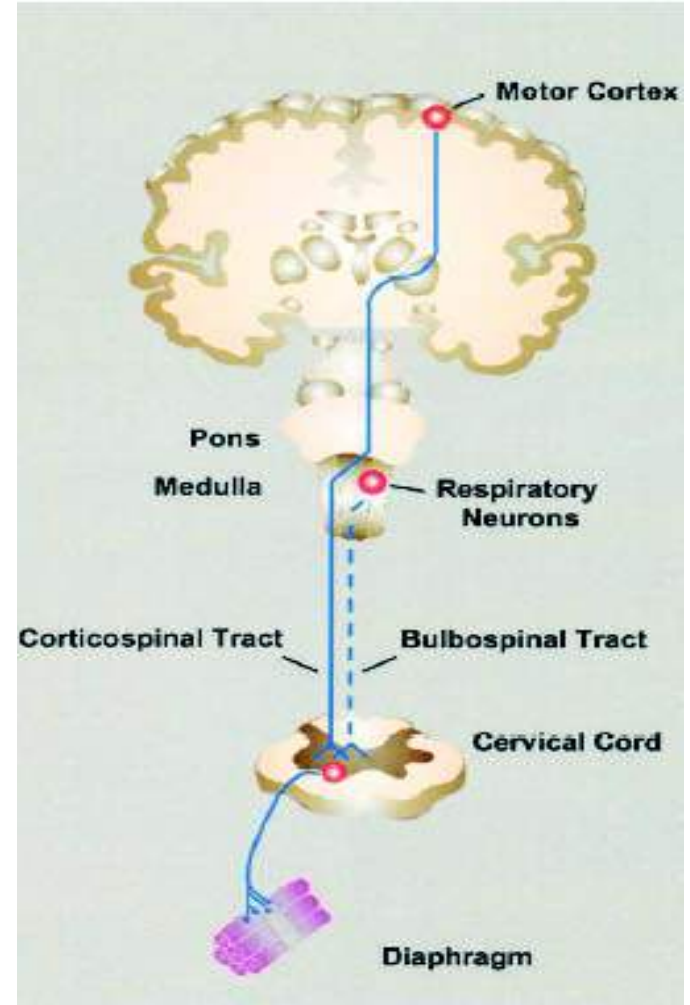
CONCLUSION: Patients with OHS can be treated with NIV during an episode of AHRF with similar efficacy and better outcomes than COPD patients.

- Akut hiperkapik respiratuar asidozlu 716 hasta
 - 173 OHS
 - 743 KOAH
- OHS hastalarında KOAH hastalarına göre
 - Daha az geç NIMV başarısızlığı %7 vs %13 (p=0.037)
 - Daha düşük hastane mortalitesi %6 vs %18 (p<0.001)
 - Bir yıllık takipteki survey daha yüksek OR 1.83 (%95 CI 1.24-2.69)
 - Hastanede kalma süresi ve 1 yıllık takip döneminde tekrar hastaneye yatma oranları benzer
- **SONUÇ:** OHS hastalarının AHSY atakları KOAH hastalarındakine benzer etkinlikte ve daha iyi sonuçlarla NIMV ile tedavi edilebilir

Nöromusküler Hastalıklar - NIMV

Nöromusküler Hastalıklar - Hiperkapnik Solunum Yetmezliği

- Musküler Hastalıklar
 - Musküler Distrofiler
 - Duchenne musküler distrofisi
 - Myotonic Distrofi
 - Polimiyozit/dermatomiyozit
- Nöromusküler Kavşak Hastalıkları
 - Myastenia gravis - Lambert Eaton Send.
 - Organofosfat zehirlenmesi
- Motor Nöron Hastalıkları
 - Amyotrofik lateral skleroz (ALS)
 - Guillain-Barre sendromu
 - Poliomyelit



Nöromusküler Hastalıklar - Hiperkapnik Solunum Yetmezliği

- NIMV HANGİ MOD?
 - Genellikle önerilen BIPAP-ST modu
 - Oto-BIPAP
 - Adaptive Servo Ventilation (ASV)
 - AVAPS (ST)

Nöromusküler Hastalıklar - Hiperkapnik Solunum Yetmezliği

- NIMV AYARLARI NASIL YAPILMALIDIR?
 - Genellikle ampirik olarak semptomlara göre
 - İlk önce akut dönem semptomları
 - Dispne
 - Göğüs kafesinin ekspansiyonu
 - Yardımcı solunum kası kullanımı
 - Hasta NIMV'ye alıştıkça;
 - Sabah baş ağrısı
 - Gündüz aşırı uykululuk hali
 - Halsizliği gidermeye yönelik ayarlar yapılır

Nöromusküler Hastalıklar - Hiperkapnik Solunum Yetmezliği

- Daha yüksek basınçlarla daha iyi sonuçlar elde edilememiş
- **EPAP** eğer altta yatan OSAS yoksa düşük ayarlanabilir (4-5 cm H₂O)
- **IPAP** çok yüksek ayarlanırsa (12-18 cm H₂O)
 - Kaçak
 - Uyumsuzluk
 - Gastrik distansiyon
 - Santral apneler
- **Backup rate** (ST mod): 12-16/dk
 - Santral apneler veya efektif olmayan solunum çabaları için

Nöromusküler Hastalıklar - Hiperkapnik Solunum Yetmezliği

- NIMV başarısı için:

- İnspiratuar kaslar
NIMV ile
desteklenirken



- Ekspiratuar kaslar
mekanik öksürük
cihazları ile
desteklenmelidir



Tesekkür Ederim