

ÖZEL DURUMLARDA MEKANİK VENTİLASYON YÖNTEMLERİ

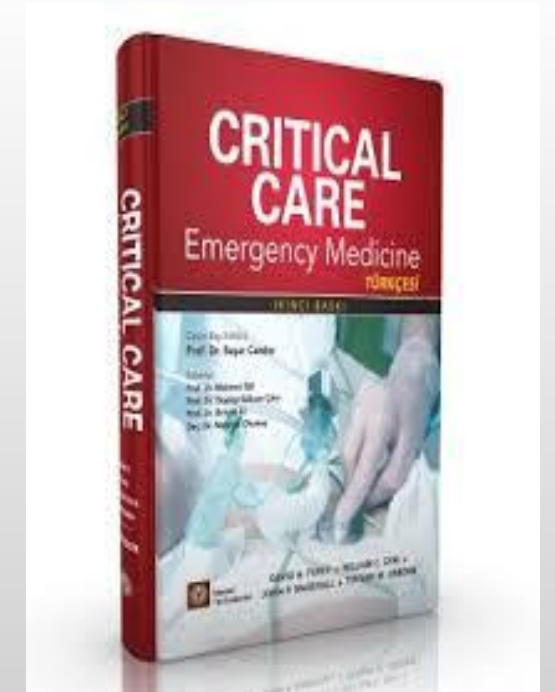
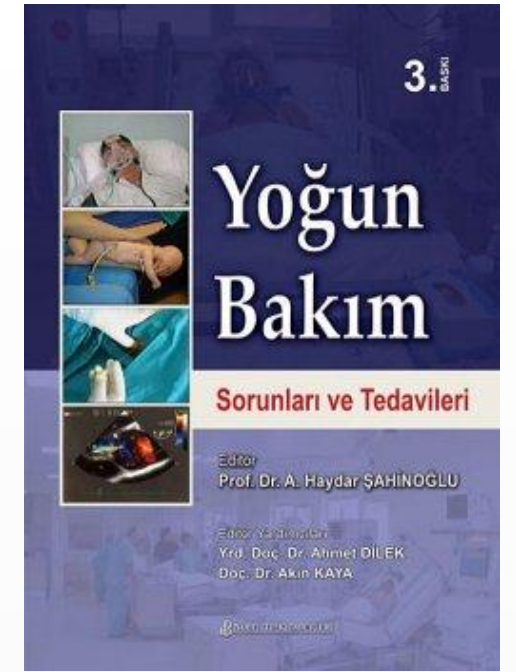
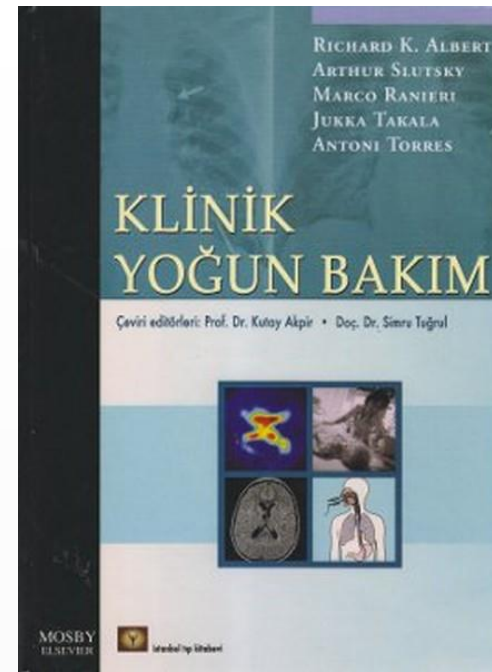
Dr. Y Kemal GÜNAYDIN
SBÜ Ankara SUAM Acil Tıp Kliniği

Kaynaklar

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SUNUM PLANI

- **Mekanik Ventilasyon Amaçları ve Endikasyonları**
- **Temel Kavramlar, Ayarlar ve Modlar**
- **Hipoksik ve Hiperkapnik Hastalarda MV**
- **KOAH alevlenmede MV**
- **Astım atakta MV**
- **ARDS'de MV**
- **Pnömonilerde MV**
- **KİBAS durumunda MV**
- **Şok durumunda MV**
- **Pediyatrik hastalarda MV**

MV Amaçları

- Mekanik ventilasyon, solunum işlevinin yapay olarak mekanik ventilatör adı verilen bir cihaz yardımı ile sağlanması işlemidir.
- Alveoler ventilasyonu sağlamak
- Yeterli oksijenizasyonu sağlamak
- Alveoler açıklığı sürdürmek
- Solunum işini azaltmak
- Sistemik oksijen tüketimini azaltmak
- İntrakraniyal basıncı azaltmak

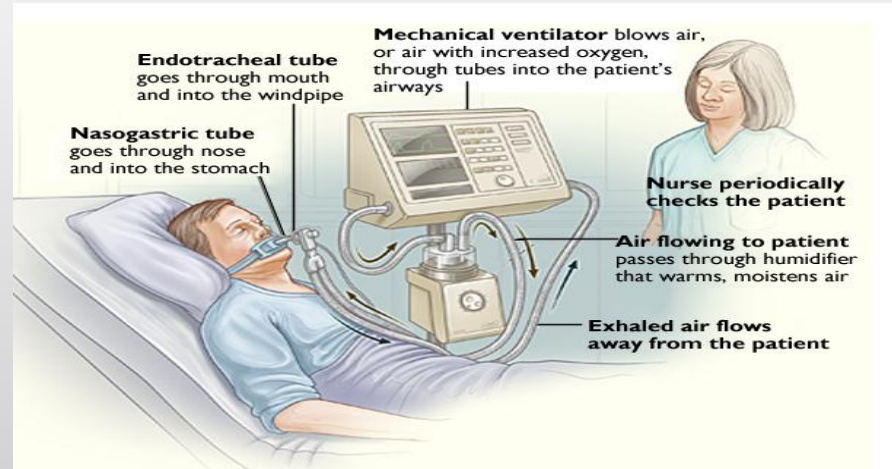
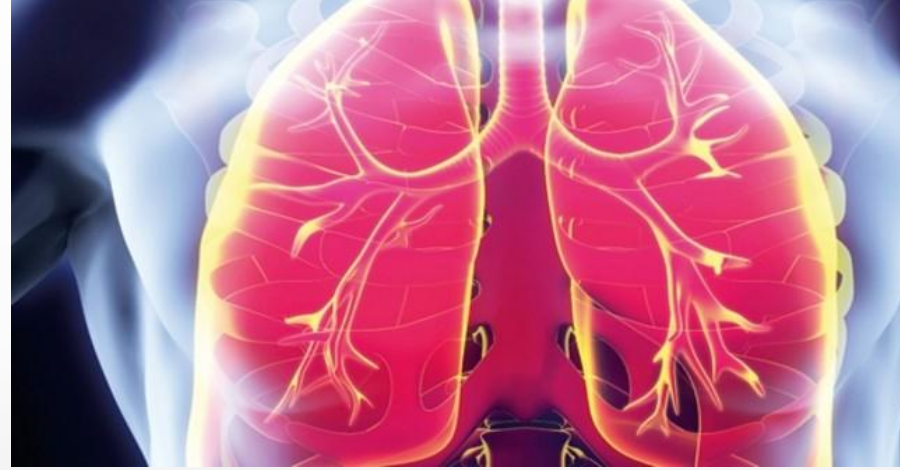
MV Endikasyonları

2 temel endikasyon

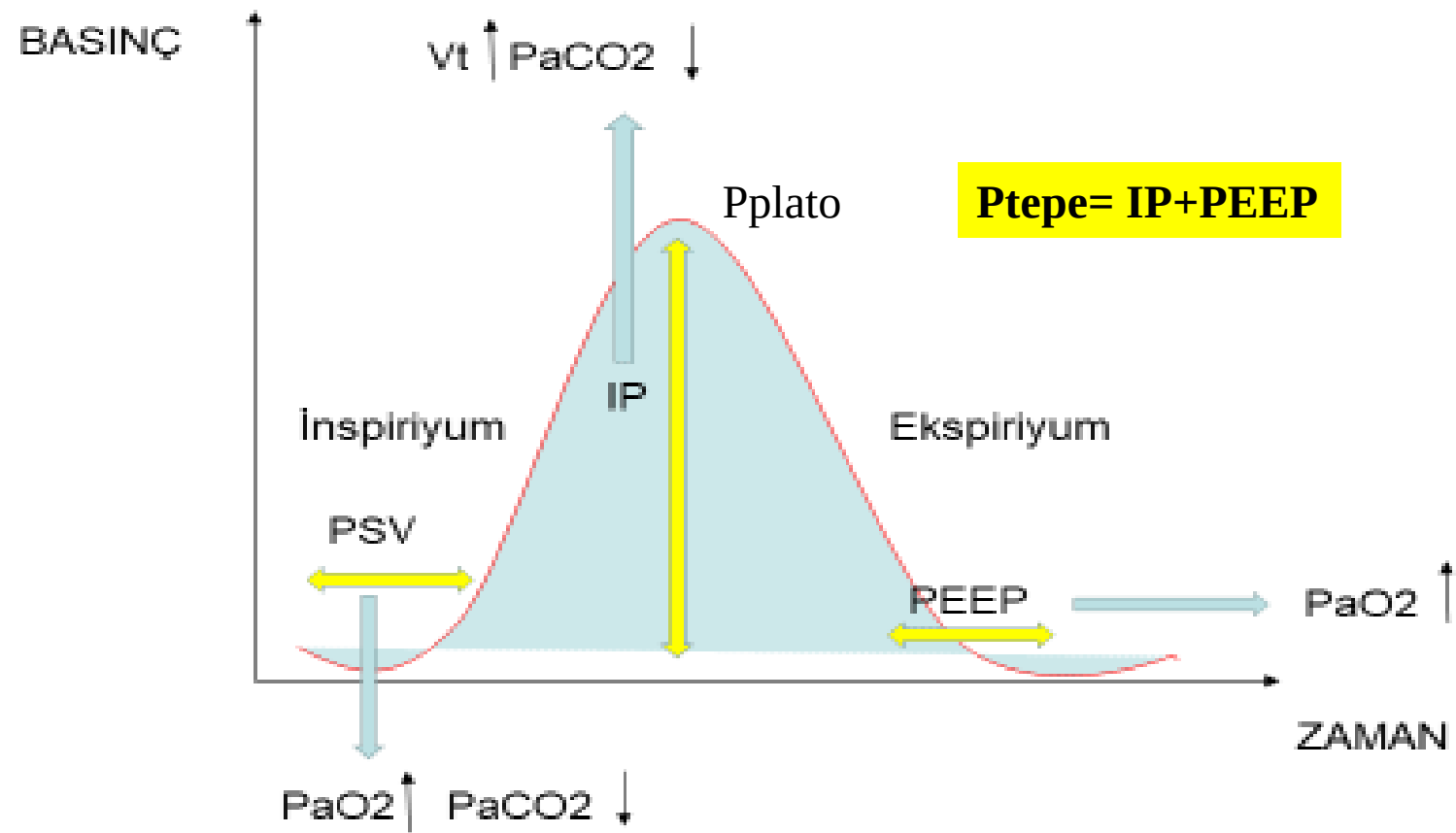
- ***Alveoler hipovekilasyon*** (solunum pompası bzkl, obstrüktif akciğer hastalıkları)
 - *Hiperkapni ve asidoz*
 - *Hipoksi*
- ***Dağılım hipoksisi***
 - *Ventilasyon / perfüzyon bozuklukları (ör: p.emboli)*
 - *Patolojik şantlar (kan yeterince oksijenlenmeden akciğerden kalbe döner)*
 - *Hiperventilasyon, hipoksemi, hipokapni ve alkaloz*

Temel Kavramlar

- Basınç kavramları
- Kompliyans
- Volüm / Hacim
- Akım
- MV siklusları
- Modlar



Basınçlar



Kompliyans (C)

- İnspirium s
- Kompliyans
 - Hem a
 - Hem d

ık adlandırılır.

İnspiratuar Rezistans

$$R_i = \frac{P_{pik} - P_{plato}}{\text{akım}}$$

Arttığı durumlar:

- Sekresyonlar
- Bronkospazm
- küçük endotrakeal tüp

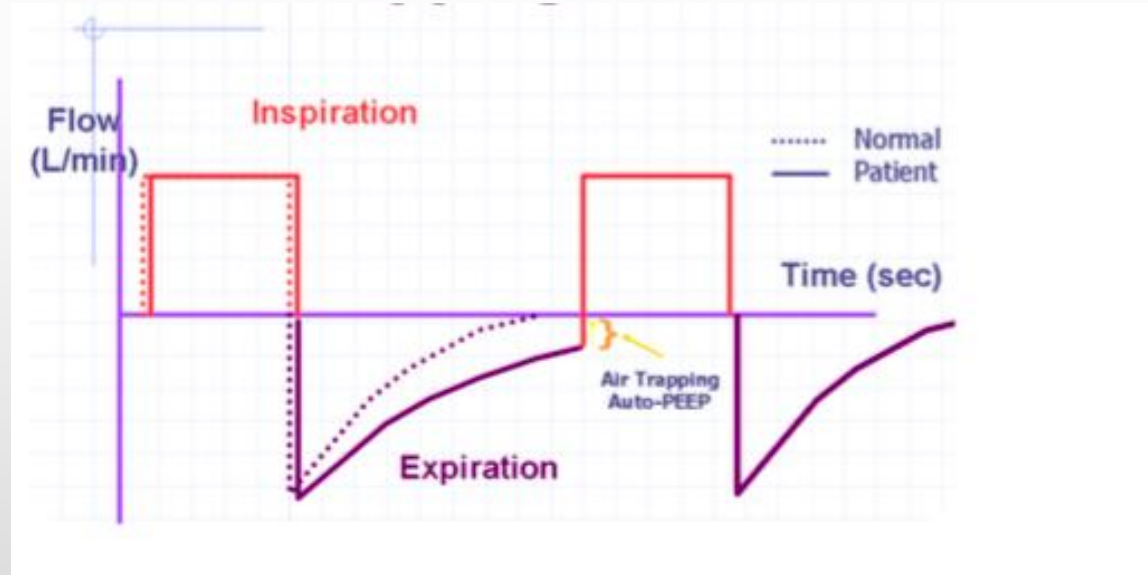
Normal: 5 - 10 cm H₂O/L/sn – MV uygulanan yetişkin

Volüm

- Mekanik ventilatör tarafından hastaya verilen hava akımının hacmine volüm denilir.
- Volüm hastaya uygulanan basınç miktarına, kompliyansa ve iletilici hava yollarının çapına bağlı olarak değişkenlik gösterebilir.
- Volüm yapılan inspiriumun süresine de bağlıdır.
 - *Örneğin KOAH hastasında İ/E oranı 1/3 yapılırsa Vti azalır*
 - *ARDS hastasında İ/E oranı 2/1 yapılırsa Vti artar*

Akım

- Her bir inspirasyon zaman birimine denk gelen volüm olarak ölçülür.
- Akım : V / T

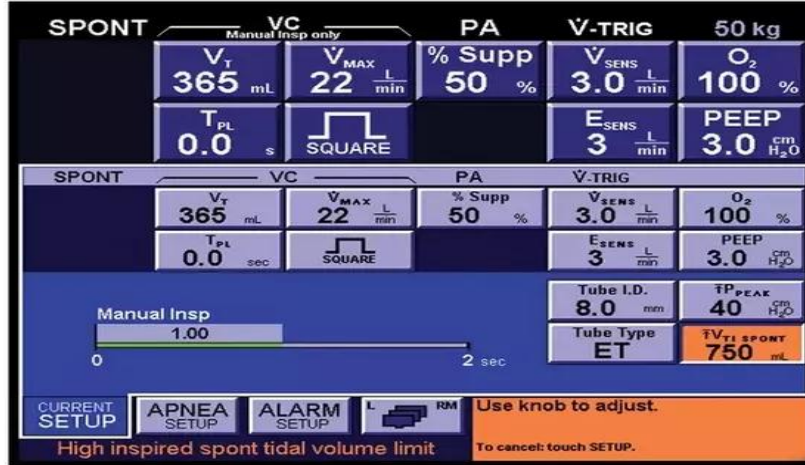


MV siklusları

- Basınç, akım ve volüm kavramlarına göre mekanik ventilasyon tipleri oluşturulmuştur.
 - *Basınç sikluslu MV (basınç kontrollü)*
 - *Volüm sikluslu MV (volüm kontrollü)*
 - *Akım sikluslu MV*
 - *Zaman sikluslu MV*

MV Temel Modları

- Mekanik ventilasyon pratiğinde inspirasyonun başlama şekli genel olarak **MOD** olarak isimlendirilir.



MV Temel Modları

■ **Zorunlu (Mandatory) solunum**

- *Solunum ventilatör tarafından başlatılır, sınırlandırılır ve sonlandırılır.*
- *Ventilatör solunumun tüm evreleri boyunca solunum işinin tümünü üstlenir.*

■ **Yardımlı (Asiste) solunum**

- *Solunum hasta tarafından tetiklenir, ventilatör tarafından sınırlandırılır ve sonlandırılır.*

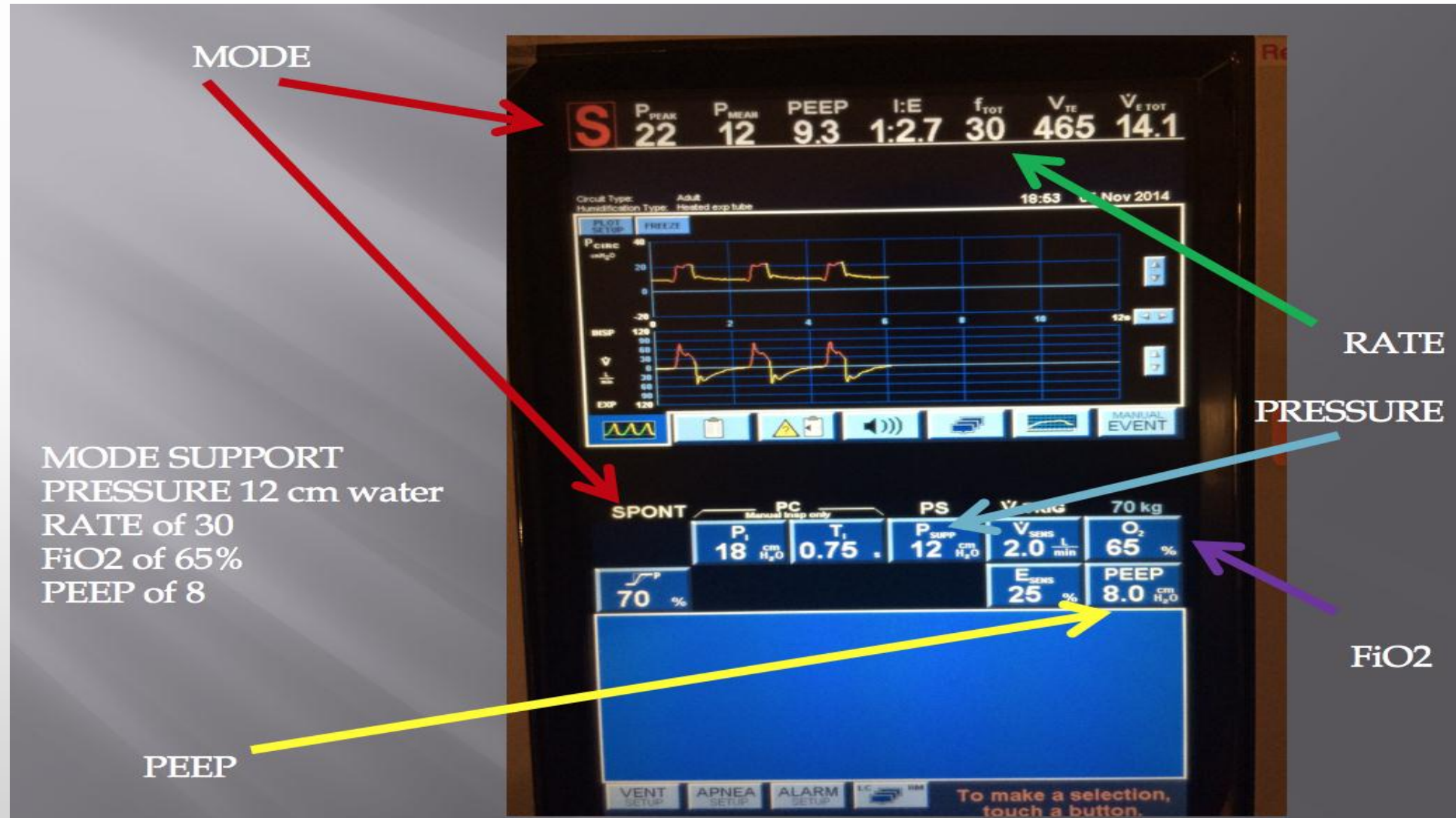
■ **Destekli (Support) solunum**

- *Solunum hasta tarafından tetiklenir, ventilatör tarafından sınırlandırılır ve hasta tarafından sonlandırılır.*
- *İnspiratuar basınçlı spontan solunum hastanın kendi solunumundan daha büyüktür.*

■ **Spontan solunum**

- *Solunum hasta tarafından başlatılır, sınırlandırılır ve sonlandırılır.*
- *Hasta solunumun tüm evreleri (faz) boyunca solunum işinin tümünü üstlenir.*

Temel ayarlar



HİPOKSİ VE HİPERKAPNİ

Solunum yetmezliği sınıflandırılması.

Akut solunum yetmezliği;

- Tip I: Akut hipoksik,
- Tip II: Akut hiperkapnik,
- Tip III: Perioperatif,
- Tip IV: Şok şeklinde sınıflandırılır.

Hipoksi ve hiperkapni

Hipoksi

- *Vt'yi arttır*
- *İnspiriumu uzat*
- *PEEP'i arttır*
- *FiO2'yi arttır*
- *Ekspiriyumu geciktir*

Hiperkapni

- *Vt'yi arttır*
- *Ekspiriyumu uzat*
- *Frekansı arttır*

KOAH ALEVLENME



KOAH alevlenme

ORIGINAL RESEARCH

Hospital Patterns of Mechanical Ventilation for Patients with Exacerbations of COPD

Peter K. Lindenauer^{1,2,3,4}, Mihaela S. Stefan^{1,2,3,4}, Meng-Shiou Shieh¹, Penelope S. Pekow^{1,5}, Michael B. Rothberg⁶, and Nicholas S. Hill⁷

¹Center for Quality of Care Research and ²Division of General Internal Medicine, Baystate Medical Center, Springfield, Massachusetts; ³Tufts Clinical and Translational Science Institute, and ⁴Division of Pulmonary and Critical Care Medicine; ⁵Tufts University School of Medicine, Boston, Massachusetts; ⁶School of Public Health and Health Sciences, University of Massachusetts, Amherst, Massachusetts; and ⁷Department of Medicine, Medicine Institute, Cleveland Clinic, Cleveland, Ohio

- KOAH hastalarında NIMV uygulanması entübasyon ve İMV ihtiyacını azaltır.
- Ayrıca mortalite oranlarında önemli düşüş sağlar.

Objectives: To describe patterns of mechanical ventilation use for patients with COPD across a large sample of hospitals, and to analyze the relationship between use of NIV and other outcomes.

Methods: Cross-sectional analysis of 77,576 patients hospitalized for COPD between June 2009 and June 2011 at 386 U.S. hospitals.

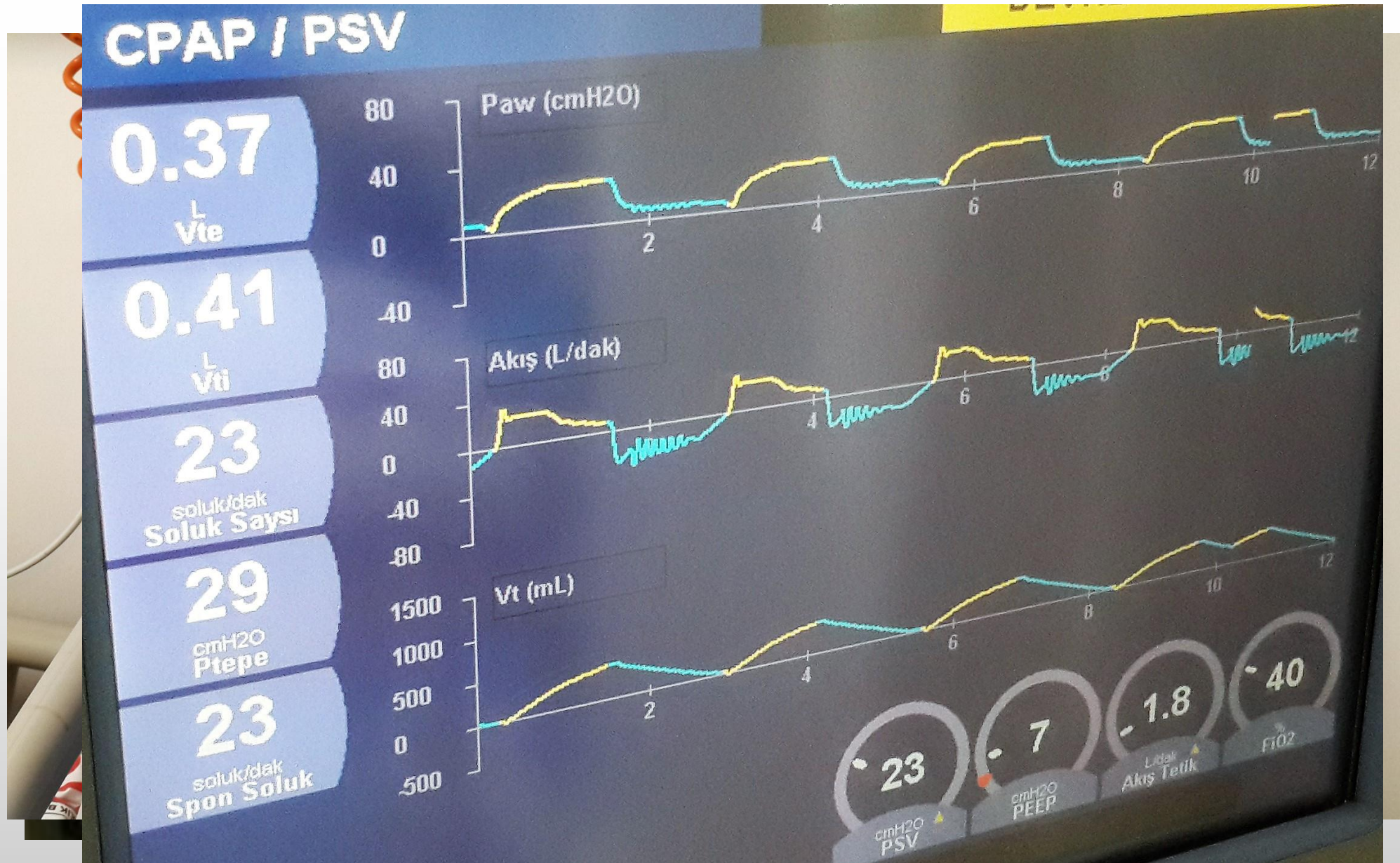
Measurements and Main Results: Using hierarchical modeling, we estimated hospital risk-standardized percentages of ventilator starts that were noninvasive (RS-NIV%). We examined the association between RS-NIV% and other outcomes, including risk-standardized rates of invasive ventilation and NIV failure, total ventilation, in-hospital mortality, length of stay, and costs. At the hospital level, the median RS-NIV% was 75.1% (range: 9.2–94.1%).

9.0%, $P = 0.01$) and marginally lower mortality rates among all patients with COPD (Q4 vs. Q1: 2.2% vs. 2.3%, $P = 0.03$) compared with hospitals with the lowest RS-NIV%. Higher RS-NIV% was associated with lower hospital costs (Q4 vs. Q1: \$11,148 vs. \$14,032, $P < 0.001$), shorter length of stay (Q4 vs. Q1: 5.5 vs. 6.8 d, $P < 0.001$), and lower NIV failure rates (Q4 vs. Q1: 12.8 vs. 32.5%, $P < 0.001$).

Conclusions: Use of NIV as the initial ventilation strategy for patients with COPD varies considerably across hospitals. Institutions with greater use of NIV have lower rates of invasive mechanical ventilation and better patient outcomes.

Keywords: COPD; costs and cost analysis; cross-sectional analysis; length of stay; outcomes research

KOAH alevlenme



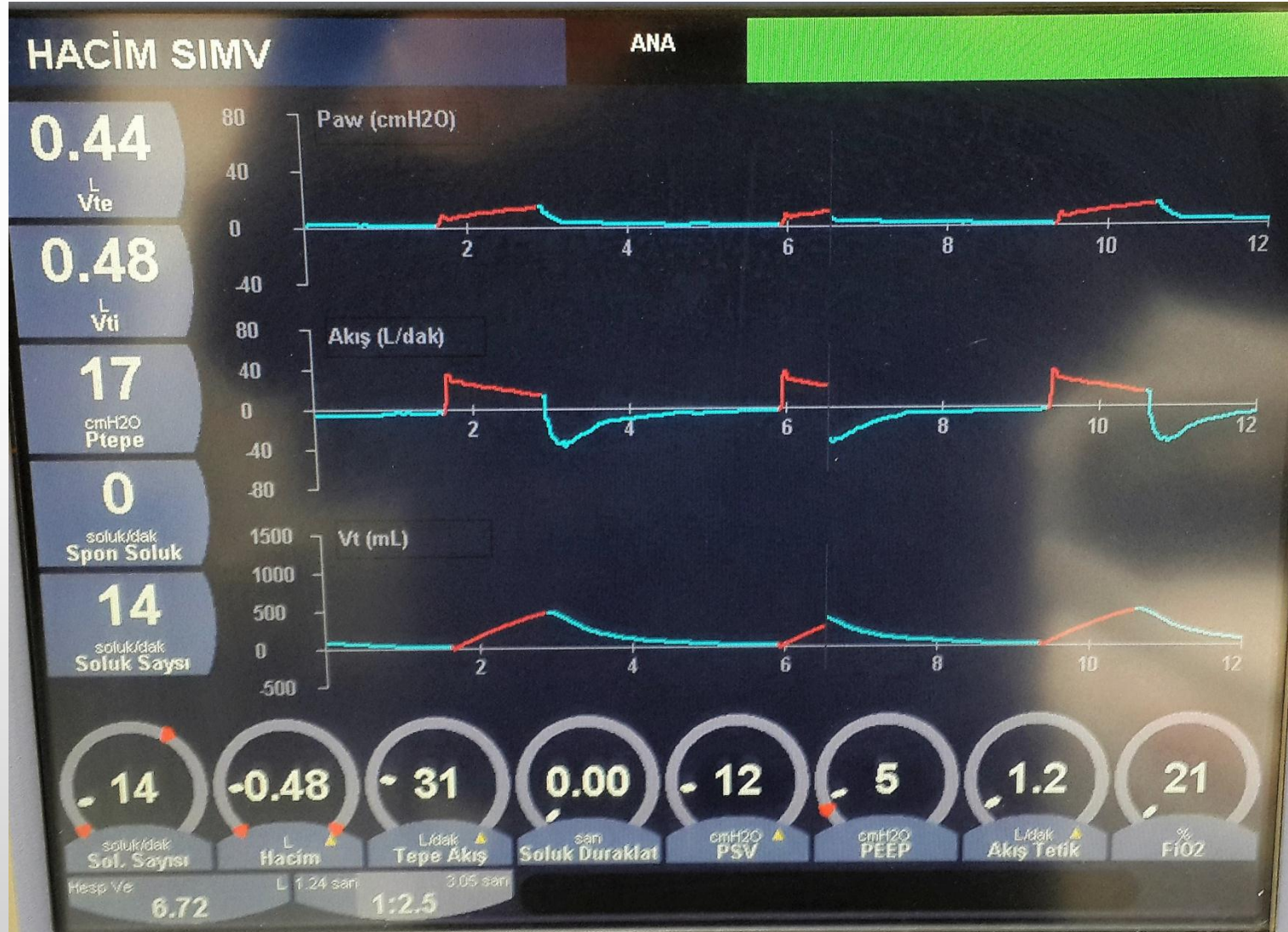
KOAH alevlenme

■ İnvaziv MV

- “ *Temel problem alveoler hipoventilasyon sonucu hiperkapni ve hipoksi* “
- *Ek sorun bu hastalarda ekspirium kısıtlı olduğu için artmış otoPEEP*

- Genelde hacim sikluslu mod seçilir
- Hipoventilasyonu düzeltmek için V_t 6-8 ml/kg şeklinde ayarlanmalı.
- Daha yüksek değerler - otoPEEP ‘i arttırır
- f değeri 14 -16 gibi ayarlanır. Solunum sayısı arttırılarak CO_2 atılımı arttırılır.
- İ/E oranı ekspirium lehine uzatılır. Yani 1/3, 1/4 gibi
- Mevcut otoPEEP ‘i aşmak için normalden biraz daha yüksek PEEP - 6 – 8 cmH₂O
- FiO₂ SaO₂ 88 – 92 arasında olacak şekilde ayarlanır
- Trigger -1 ile -2 lt/dk ayarlanmalı

KOAH alevlenme



ASTIM ATAK





ORIGINAL ARTICLE

Is non-invasive ventilation safe in acute severe asthma?

MICHAEL PALLIN, MARK HEW AND MATTHEW T. NAUGHTON

Department of Allergy, Immunology and Respiratory Medicine, Alfred Hospital and Monash University, Melbourne, Victoria, Australia

Noninvasive ventilation

Michael Pallin, MB

Department of Allergy, Immunology and Respiratory Medicine

ARTICLE INFO

Keywords:

Noninvasive ventilation

Astım hastaları için non-invaziv ventilasyonun güvenli ve etkili olduğu, ancak hastanede kalış süresi için yeterli veriler yoktur.

ABSTRACT

Background and objective: The effect of non-invasive ventilation (NIV) in acute severe asthma is unclear and there are concerns regarding its safety.

Methods: We undertook a 5-year case–control review of mortality and morbidity associated with NIV use in acute severe asthma and compared this with asthma requiring invasive mechanical ventilation (IMV) and a control group with less severe asthma without ventilatory support.

Results: Eight hundred seventy-three patients had acute severe asthma of whom 30 were treated with NIV, 17 with IMV and 90 served as controls. The mean duration of NIV was 9.5 ± 7.3 h with inspiratory positive airway pressure and expiratory positive airway pressure of 11.9 ± 1.4 and 5.8 ± 1.2 cmH₂O respectively. Mortality was zero in the NIV and control groups, compared with 41% in the IMV group. None of the NIV or control groups required escalation to invasive ventilation. There were no instances of haemodynamic compromise in the NIV or control groups. Length of hospital stay was 121 ± 96 h in the NIV group and similar to the severe IMV group (136 ± 99 h, $P > 0.05$) and significantly longer than the control group (42 ± 40 h, $P < 0.05$).

Conclusions: NIV can be safely used in acute severe asthma although further work is needed to delineate the precise patient selection process.

Key words: asthma, mechanical ventilation, morbidity, mortality, non-invasive ventilation.

SUMMARY AT A GLANCE

The role of non-invasive ventilation in acute asthma is not well described and there are concerns about its safety. Over a 5-year period, non-invasive ventilation was used without significant complications in patients with moderate acute severe asthma.

Despite standard care in the management of acute asthma,^{2,3} asthma still causes 1 in every 250 deaths.⁴ Acute exacerbations of asthma requiring hospital admission are associated with a mortality of between 0.4% and 0.9%.^{5,6} However, in the setting of a severe exacerbation necessitating intensive care unit admission, often with invasive mechanical ventilation (IMV), mortality may approach 10%.²

Despite standard care in the management of acute asthma,⁷ some patients fail to improve and require endotracheal intubation for IMV. Although lifesaving in dire circumstances, IMV should also be used with caution, as it is associated with significant complications in asthmatics. Mortality is estimated to be three times as high in those patients receiving IMV compared with non-ventilated asthmatics;⁸ barotrauma occurs in 2–6% of patients;^{9,10} ventilator-associated pneumonia may occur as often as 7%;^{9,10} generalized, including respiratory muscle weakness occurs in up to 13% of patients⁹ and intensive care unit/hospital

admission, however, remains controversial. In

Non-invaziv ventilasyonun astım hastaları için güvenli ve hastanede kalış süresi için yeterli veriler yoktur.

Despite standard care in the management of acute asthma,⁷ some patients fail to improve and require endotracheal intubation for IMV. Although lifesaving in dire circumstances, IMV should also be used with caution, as it is associated with significant complications in asthmatics. Mortality is estimated to be three times as high in those patients receiving IMV compared with non-ventilated asthmatics;⁸ barotrauma occurs in 2–6% of patients;^{9,10} ventilator-associated pneumonia may occur as often as 7%;^{9,10} generalized, including respiratory muscle weakness occurs in up to 13% of patients⁹ and intensive care unit/hospital

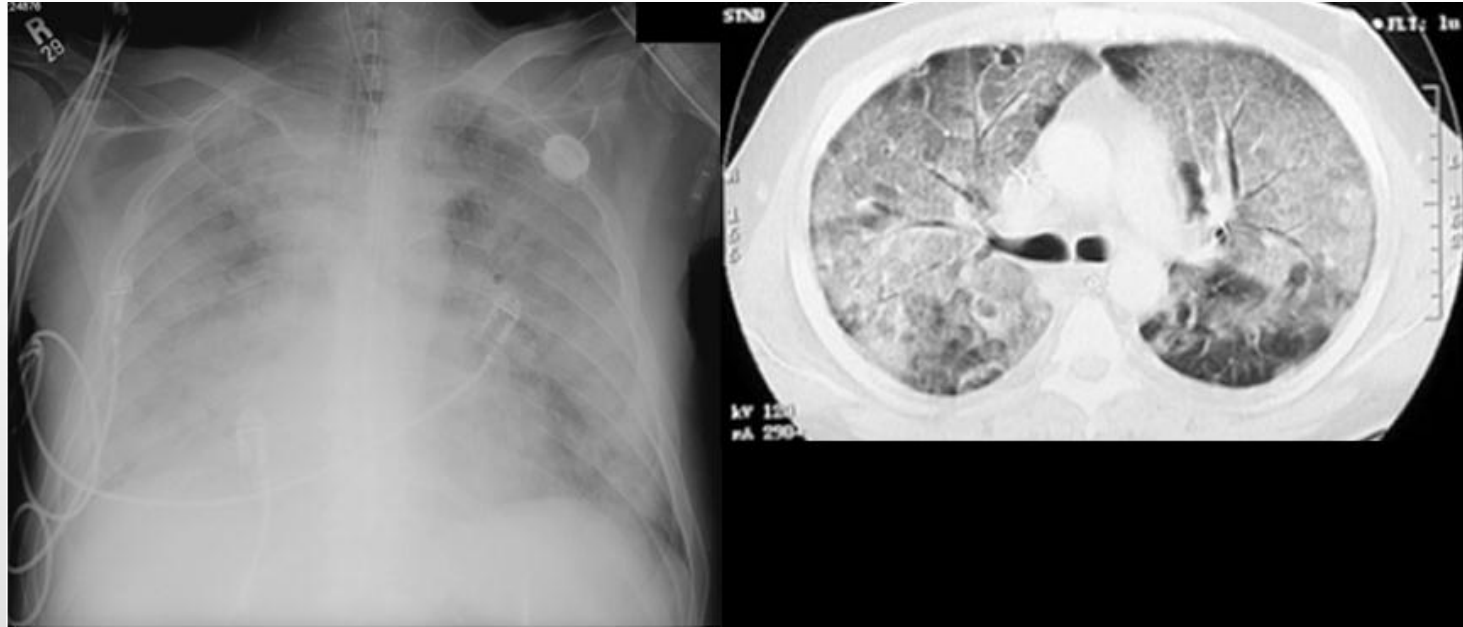
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Astım Atak

■ İnvaziv MV

- *Temel problem hava yolu obstrüksiyonu ve ekspirium kısıtlılığı - hiperinflasyon*
- Genelde hacim sikluslu mod seçilir
- V_t 6-8 ml/kg şeklinde ayarlanmalı
- Azaltılmış tidal volüm ve solunum sayısı - permissive hypercapnia
- f değeri 10 -12 gibi ayarlanır. İ/E oranı ekspirium lehine uzatılır. Yani 1/3, 1/4 gibi
- PEEP ortalama 5 cmH₂O – otoPEEP'in %80'i kadar arttırılabilir.
- Trigger -2 lt/dk ayarlanmalı
- FiO₂ SaO₂ 88 – 92 arasında olacak şekilde ayarlanır

ARDS





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Noninvasive ventilation in acute respiratory distress syndrome: Primum non nocere[☆]



ARDS olgularında sadece seçilmiş vakalarda NIMV denenebilir.

1- Hafif şiddette ARDS

2- Organ yetmezliği ya da şok tablosunda olmayan

NIMV 1-3 saat denenir ve şayet başarısız ise İMV geçilmeli

We read with interest the article by the authors describing their study on noninvasive ventilation (NIV) in acute respiratory distress syndrome (ARDS). The authors conclude that NIV is not superior to invasive mechanical ventilation (IMV) in a high Acute Respiratory Distress Syndrome (ARDS) predicted NIV group. NIV in ARDS has several major limitations.

The authors do not provide any data on the trends of clinical and blood gas parameters after the initiation of NIV. No details have been provided on the inspiratory and expiratory positive airway pressure administered during NIV. Furthermore, the study included patients even with hypotension and severe hypoxemia. The current evidence does not support the use of NIV in patients with hemodynamic instability, multiorgan dysfunction, and severe hypoxemia ($Pao_2/Fio_2 < 100$), mak-

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MD, DM

Sahajal Dhooria, MD, DM

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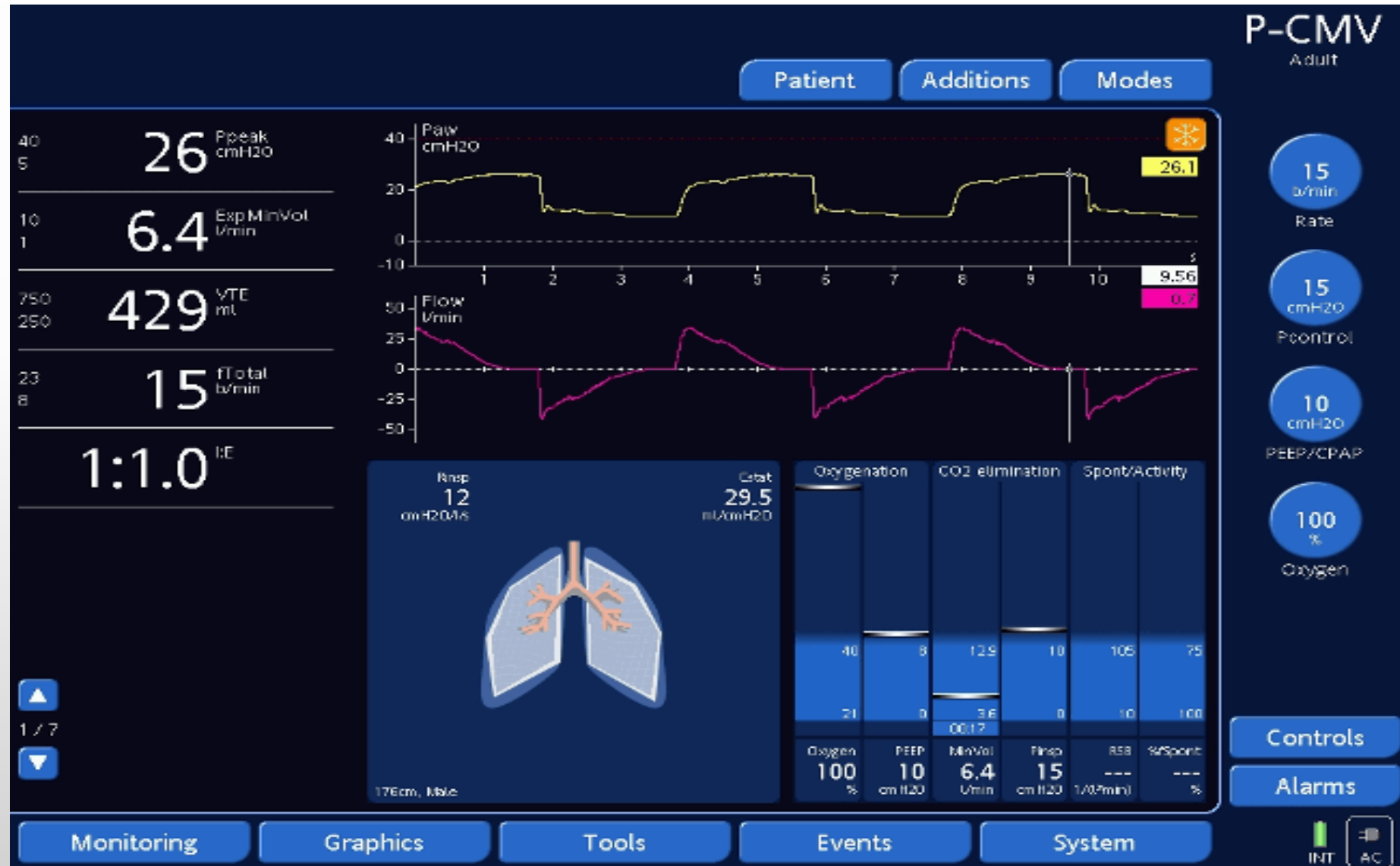
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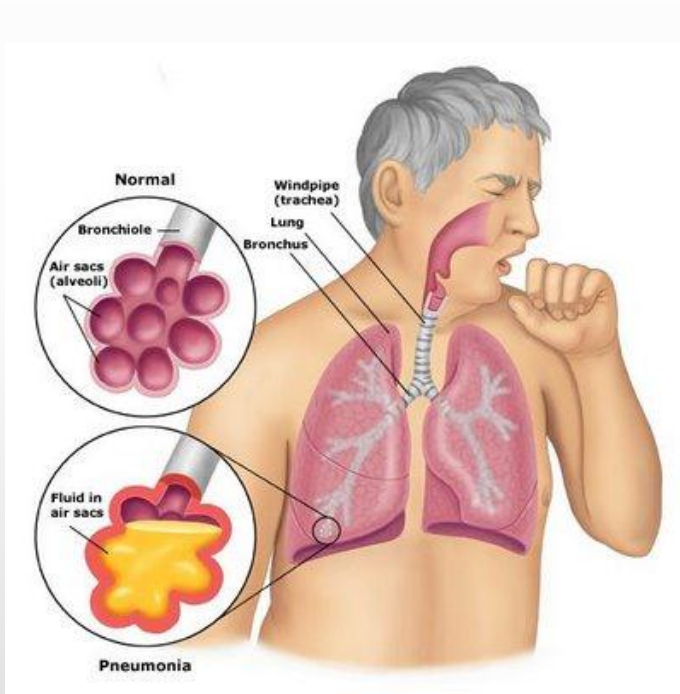
Department of Pulmonary and Critical Care Medicine, Postgraduate Institute of Medical Sciences, University of Health Sciences, Rohtak, Haryana, India

ARDS



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PNÖMONİ





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Review

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Article histor

Received 20

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Accepted 21

Available on

Keywords:

Non-invasiv

Acute hypo

Severe pneu

Continuous

The role of noninvasive positive pressure ventilation in community-acquired pneumonia☆☆☆★

A. Murad, MD^a, P.Z. Li, MSc^b, S. Dial, MSc^b, J. Shahin, MSc^{b,c,*}

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^b Respiratory Epidemiology Clinical Research Unit, Montreal Chest Institute and Critical Care Medicine, SMBD-Jewish General Hospital, McGill University, Montreal, Quebec, Canada

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Akut solunum yetmezliği gelişen toplum kaynaklı pnömoni olgularında NIMV yüksek oranda başarısızlıkla sonuçlanmaktadır.

Outcomes

intensive care units from January 2007 to January 2012 with the principal diagnosis of CAP and requiring positive pressure ventilation was carried out. The primary outcome was acute hospital mortality. Univariable and multivariable analysis were performed to assess the association between mode of ventilation and death as well as factors associated with failure of NIV.

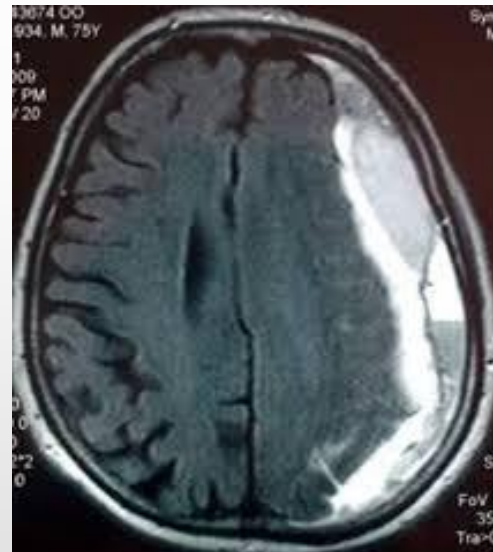
Results: A total of 229 patients were admitted, with 20 patients excluded from the analysis because of do-not-resuscitate orders. Fifty-six percent of patients were initially treated with NIV. Of those, 76% failed NIV and required intubation and invasive ventilation. After adjusting for confounders, no difference in mortality was seen between patients who received NIV as first-line therapy in comparison with patients who received invasive ventilation (odds ratio [OR], 1.63; 95% confidence interval [CI], 0.81–3.28; $P = .17$). Multivariable analysis demonstrated a trend toward increased NIV failure for the patients who had higher Acute Physiology and Chronic Health Evaluation II scores ($P = .07$) and vasopressor use at 2 hours after initiation of positive pressure ventilation (OR, 7.5; 95% CI, 1.8–31.3, $P = .006$). In an adjusted analysis, patients who failed NIV had an increased odds of death when compared with patients who were treated with invasive ventilation (OR, 2.2; 95% CI, 1.0–4.8; $P = .03$).

Conclusion: Noninvasive pressure ventilation is frequently used in CAP but is associated with high failure rates. Mortality was not improved in the group of patients who received NIV as first-line therapy despite clinical characteristics that might have suggested a more favorable prognosis. Given the high rates of NIV use, high failure rates, and the hypothesis generating nature of the data in this study, further randomized studies are needed to better delineate the role of NIV in CAP.

Pnömoni



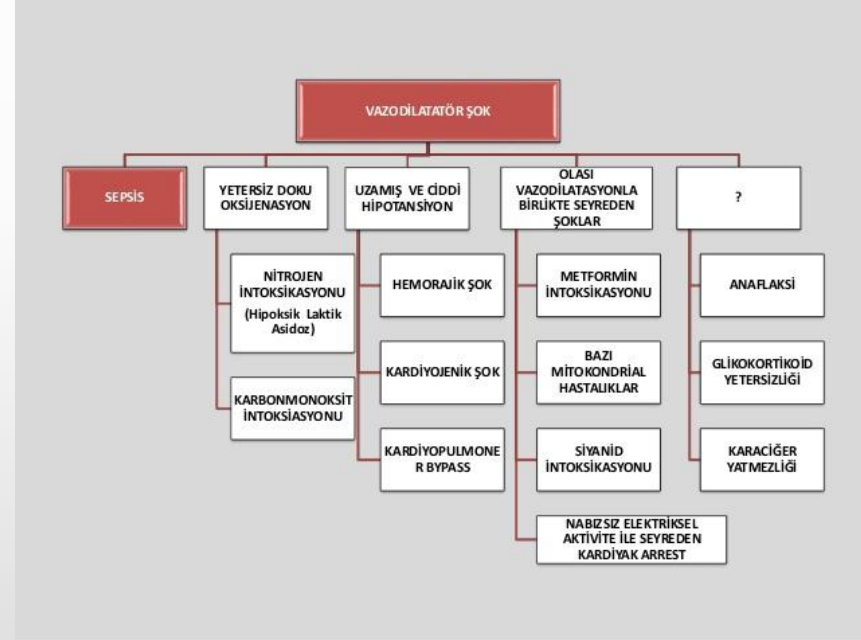
KİBAS



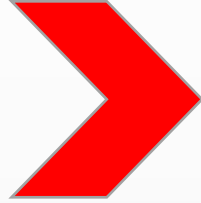
KİBAS

- Herniasyon bulguları ya da akut nörolojik kötüleşme varsa **hiperventilasyon** akut dönemde kısa süreli uygulanabilir. $\text{PaCO}_2 < 25 \text{ mmHg}$ olmamalı (ATLS - Class 2B öneri)
 - $F: 14 - 18 /dk$
 - $V_t 8-10 \text{ ml} / \text{kg}$
- DİKKAT !!!
 - Artan intratorasik basınç kafa içi basıncını artırır.
 - Hipotansiyon  $OAB (80-100) - KİB (10-15) = SPB (70-80)$
 - PaCO_2 düşmesi  serebral damarlarda VK / iskemi ve serebral perfüzyon bozulur

ŞOK



ŞOK

- İMV sırasında yüksek Vt ya da basınç intratorasik basıncı artırır.
 - Yüksek PEEP
 - Yüksek IP
 - Yüksek Vt
- 
- Hipotansiyon**
- Bu nedenle OAB düzelene kadar ya da inotropik ilaçlar etkisini gösterene kadar,
 - *Düşük PEEP*
 - *Düşük IP*
 - *Düşük Vt*

PEDİYATRİK HASTALARDA MV



Pediyatrik hastalarda ilk ayarlar

Lung protection strategy for patients with inadequate oxygenation (eg, PARDS)

- PIP: Adjust for target tidal volume 4 to 6 mL/kg (maximum 10 mL/kg); higher PIP (up to 30 to 40 cm H₂O) required for poor lung compliance
- PEEP: Increase for hypoxemia, atelectasis, may be >10 cm H₂O
- SpO₂: Target 88 to 92%/55 to 88 mmHg
- PaO₂: Target 88 to 92%/55 to 88 mmHg

Obstructive airway disease causing inadequate ventilation (eg, status asthmaticus or bronchiolitis)

- RR: Near or below physiologic to prevent breath-stacking and dynamic hyperinflation
- I_T: Low/normal, goal I:E of 1:3 to 1:5 or greater
- PIP: >Plateau pressure and <40 cm H₂O
- PaCO₂: Permissive hypercapnia, goal pH >7.20

Airway protection

- Minimize settings to maintain adequate oxygenation and ventilation and avoid ventilator-associated lung injury

Volüm Kontrollü

VC	Infant (<1 year of age)	Toddler/child (1 to 12 years)	Adolescent (>12 years)
Tidal volume (mL)	5 to 8 mL/kg (healthy lungs)	5 to 8 mL/kg (healthy lungs)	5 to 8 mL/kg (healthy lungs)
	3 to 6 mL/kg (lung protective strategy)	3 to 6 mL/kg (lung protective strategy)	3 to 6 mL/kg (lung protective strategy)
Rate (breaths/minute)	20 to 30	15 to 25	12 to 20
PEEP (cm H ₂ O)	3 to 8	3 to 8	3 to 8
Pressure support (cm H ₂ O) [¶]	Minimum 6 to 10	Minimum 6 to 10	Minimum 6 to 10
Peak inspiratory flow (L/minute)	Adjusted to fit desired inspiratory time	Adjusted to fit desired inspiratory time	Adjusted to fit desired inspiratory time
Inspiratory time (seconds) Targeted, based upon changes to inspiratory flow	0.4 to 0.6	0.7 to 0.9	0.9 to 1.2
FiO ₂ (%) ^Δ	Start with 1.0, rapidly wean to ≤0.6	Start with 1.0, rapidly wean to ≤0.6	Start with 1.0, rapidly wean to ≤0.6
Flow trigger (L/minute)	0.25 to 0.5	0.8 to 2	0.8 to 2
Pressure support cycle	10 to 25% of peak flow rate	10 to 25% of peak flow rate	10 to 25% of peak flow rate

VOLUME SIMV+PS

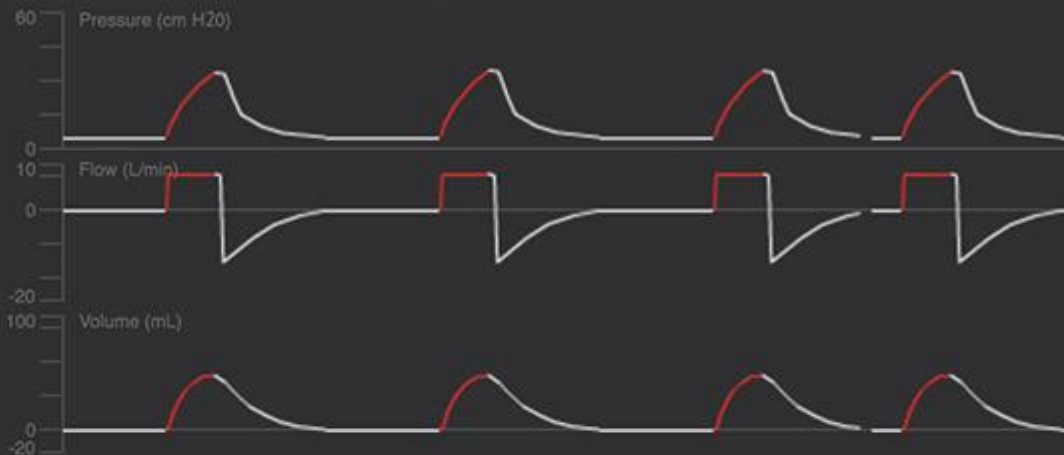
29 cm H₂O
PIP

48.2 mL
V_{TE}

8.04 mL/kg
V_{TE}

1.20 L/min
MV

9 cm H₂O
MAP



48 mL

Tidal Volume

8 L/min

Peak Flow

25 bpm

Mandatory Breath Rate

5 cm H₂O

PEEP

5 cm H₂O

Pressure Support

0.5 L/min

Trigger Sensitivity

40 %

FiO₂

Insp. Time: 0.4s

Increase
Oxygen

Insp Hold

Exp Hold



Accept



Silence
Alarm

Alarms

Mode



Basınç Kontrollü

PC	Infant (<1 year of age)	Toddler/child (1 to 12 years)	Adolescent (>12 years)
PIP (cm H ₂ O) [¶]	16 to 25	16 to 25	16 to 25
PEEP (cm H ₂ O) [¶]	3 to 7	3 to 7	3 to 7
Rate (breaths/minute)	20 to 30	15 to 25	12 to 20
Inspiratory time (seconds)	0.4 to 0.6	0.7 to 0.9	0.9 to 1.2
Pressure support (cm H ₂ O) ^Δ	Minimum 6 to 10	Minimum 6 to 10	Minimum 6 to 10
FiO ₂ (%) [◇]	Start with 1.0, rapidly wean to ≤0.6	Start with 1.0, rapidly wean to ≤0.6	Start with 1.0, rapidly wean to ≤0.6
Flow trigger (L/minute)	0.25 to 0.5	0.8 to 2	0.8 to 2
Pressure support cycle	10 to 25% of peak flow rate	10 to 25% of peak flow rate	10 to 25% of peak flow rate

PRESSURE SIMV+PS

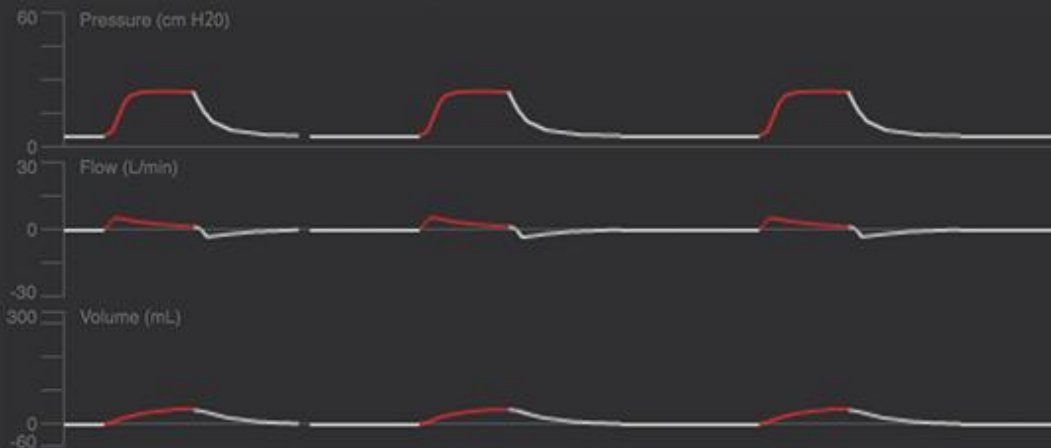
20 cm H₂O
PIP

38.2 mL
V_{TE}

1.91 mL/kg
V_{TE}

0.77 L/min
MV

9 cm H₂O
MAP



15 cm H₂O

Delta Pressure

0.80 sec

Insp. Time

20 bpm

Mandatory Breath Rate

5 cm H₂O

PEEP

5 cm H₂O

Pressure Support

1.0 L/min

Trigger Sensitivity

100 %

FIO₂

Increase
Oxygen

Insp Hold

Exp Hold

Accept

Silence
Alarm

Alarms

Mode



ACİL KRİTİK YOĞUN BAKIM KURSU

ANKARA ŞEHİR HASTANESİ 3-4 MAYIS 2019



Kurs Direktörü: Prof. Dr. Başar CANDER
Direktör Yardı: Doç. Dr. Y. Kemal GÜNAYDIN
Doç. Dr. Yavuz KATIRCI

ACİL YOĞUN BAKIM KURSU - 2018

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			Doç. Dr. Mustafa KATIRCI	Doç. Dr. Mustafa KATIRCI
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