



Adaptive Support Ventilation (ASV)

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İç Hastalıkları AD

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Yoğun Bakım Ünitesi

MV-Tarihçe



MV-Tarihçe



George POE

UNITED STATES PATENT OFFICE.

GEORGE POE, OF SOUTH NORFOLK, VIRGINIA, ASSIGNOR OF ONE-FOURTH TO HARRIET LOUISE OSTRANDER, ONE-FOURTH TO THOMAS BLACK, OF SOUTH NORFOLK, VIRGINIA, AND ONE-FOURTH TO FRANCIS M. MORGAN, OF BERKLEY, VIRGINIA.

MACHINE FOR INDUCING ARTIFICIAL RESPIRATION.

No. 859,778.

Specification of Letters Patent.

Patented July 9, 1907.

Application filed October 11, 1906. Serial No. 338,392.

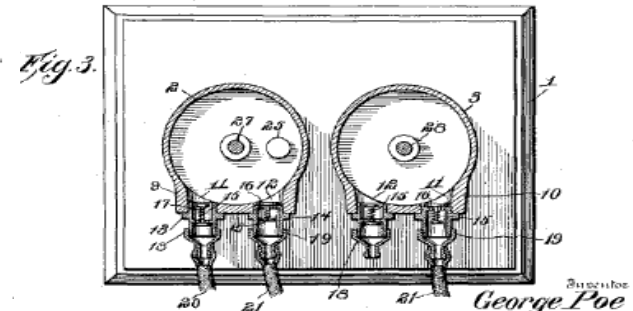
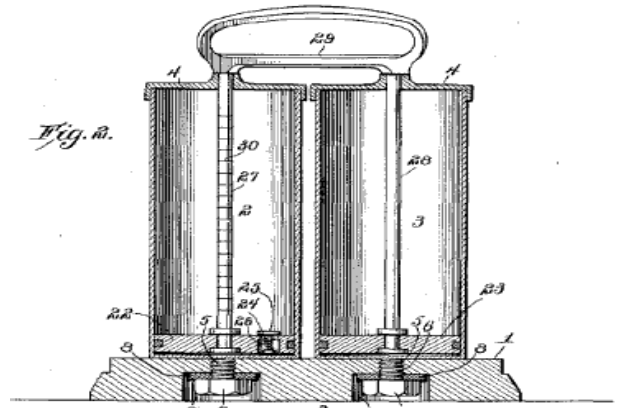
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G. POE.
MACHINE FOR INDUCING ARTIFICIAL RESPIRATION.

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2 SHEETS-SHEET 2.



Louis A. Hennrich
Geo. A. Schuman Jr

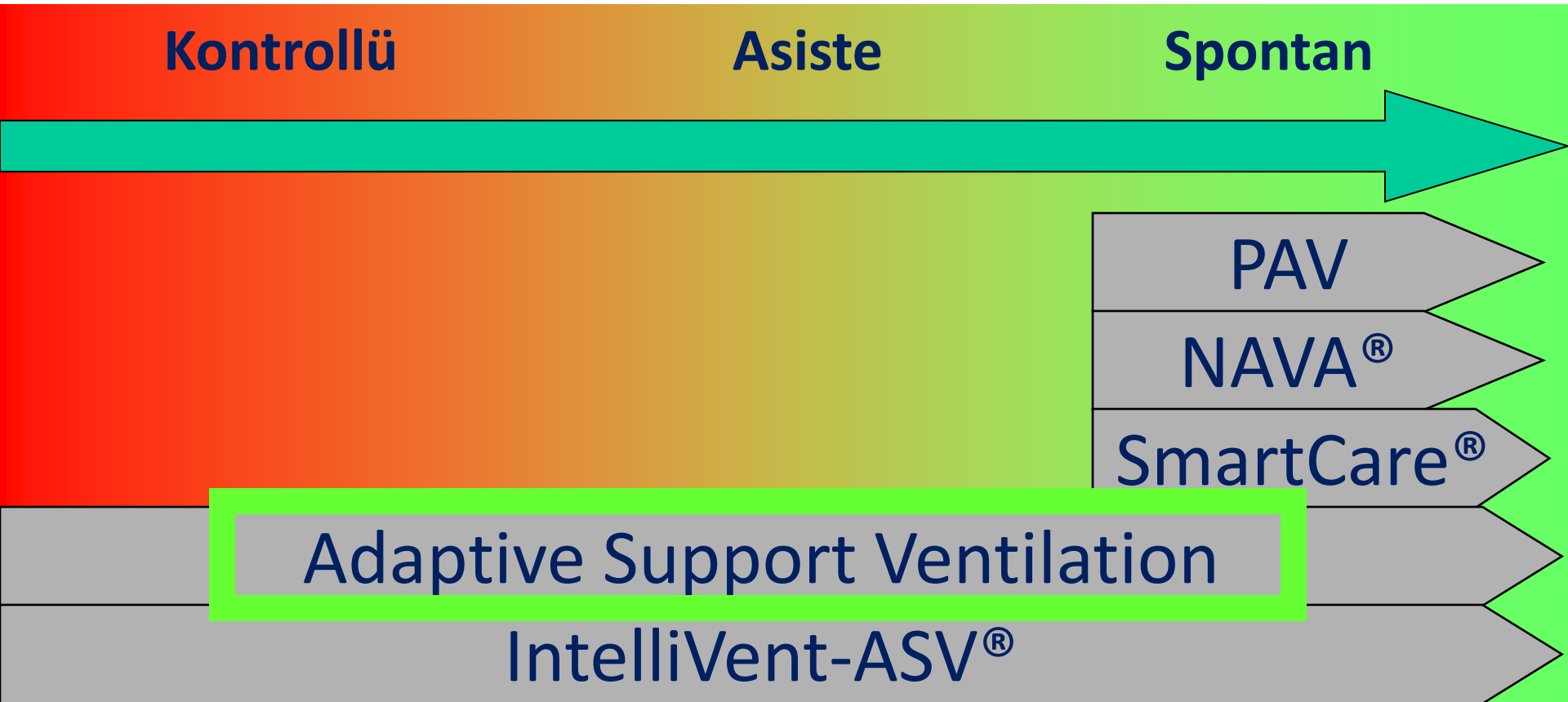
George Poe
Victor J. Evans
Attorney

MV-Tarihçe

Pozitif basıncılı ventilasyon (1950 -)



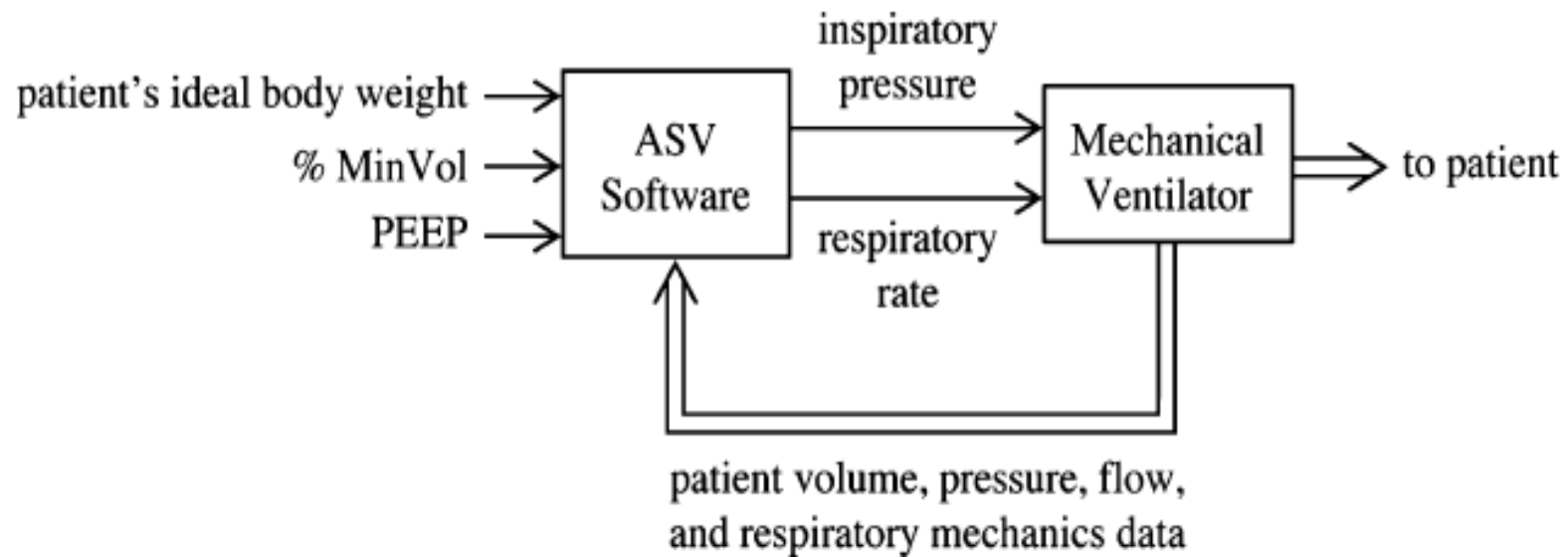
Pazardaki çözümler



ASV

AUTOMATIC CONTROL OF MECHANICAL VENTILATION. PART 2: THE EXISTING TECHNIQUES AND FUTURE TRENDS

Fleur T. Tehrani, PhD^{1,2}



ASV

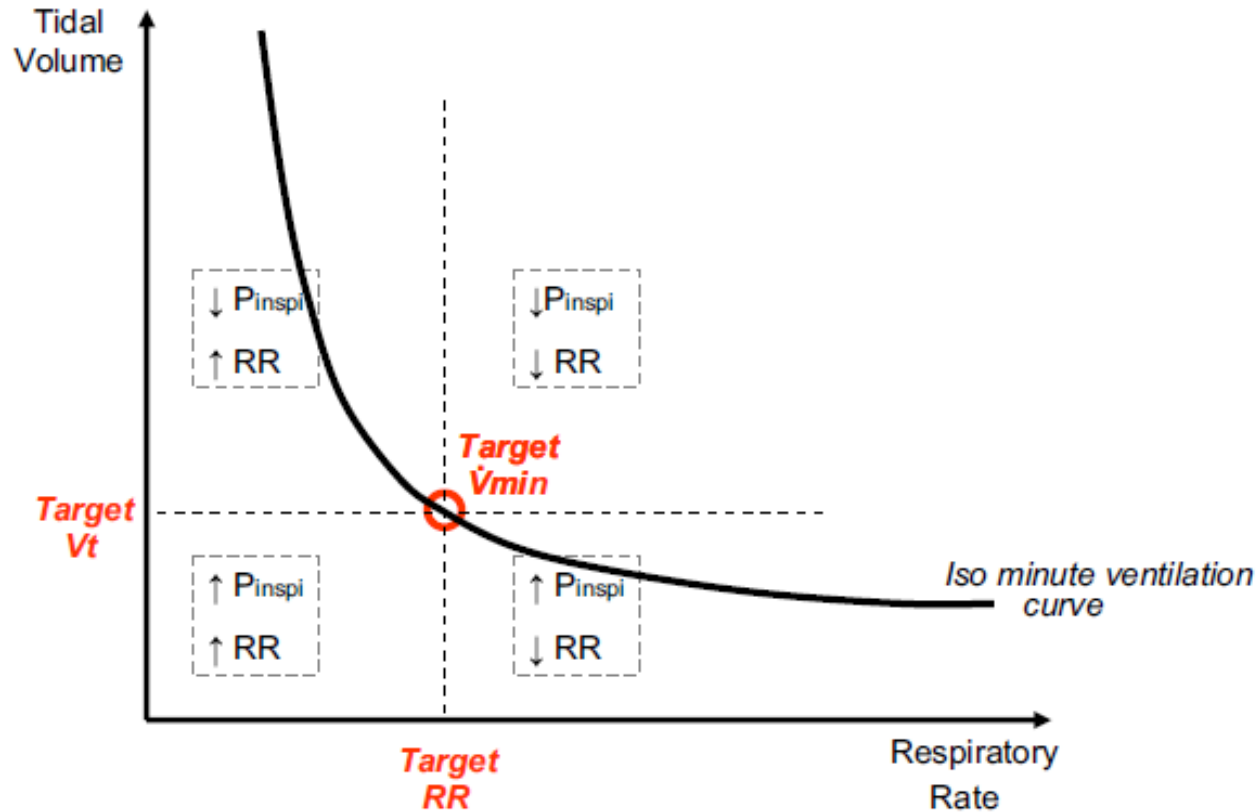
7

Advanced closed loops during mechanical ventilation (PAV, NAVA, ASV, SmartCare)

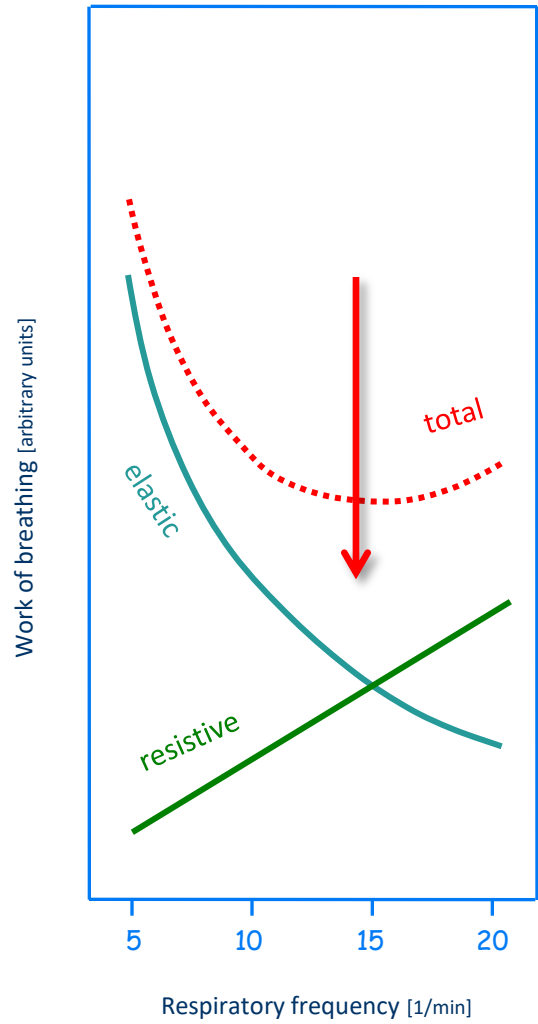
François Lellouche, MD, PhD, Doctor^{a,*}, Laurent Brochard, MD, Professor^b

^aInstitut Universitaire de Cardiologie et de Pneumologie de l'Hôpital Laval, Centre de Recherche de l'Hôpital Laval, 2725, chemin Sainte-Foy, G1V4G5, Québec, QC, Canada

^bService de Réanimation Médicale, Hôpital Henri Mondor, 51, Avenue du Maréchal de Lattre de Tassigny, 94010 Créteil, France



NORMAL



WOB_{TOT}

WOB_{elas}

WOB_{res}

Otis eşitliği

$$f = \frac{1 + 2a * RC * \frac{MinVol - (f * V_d)}{V_d} - 1}{a * RC}$$

f – respiratory rate

RC – time constant

MinVol – Minute ventilation

V_d – dead space

$$a - \frac{2\pi^2}{60} = 0,33 \text{ (constant for sinusoidal flow)}$$

modified from:

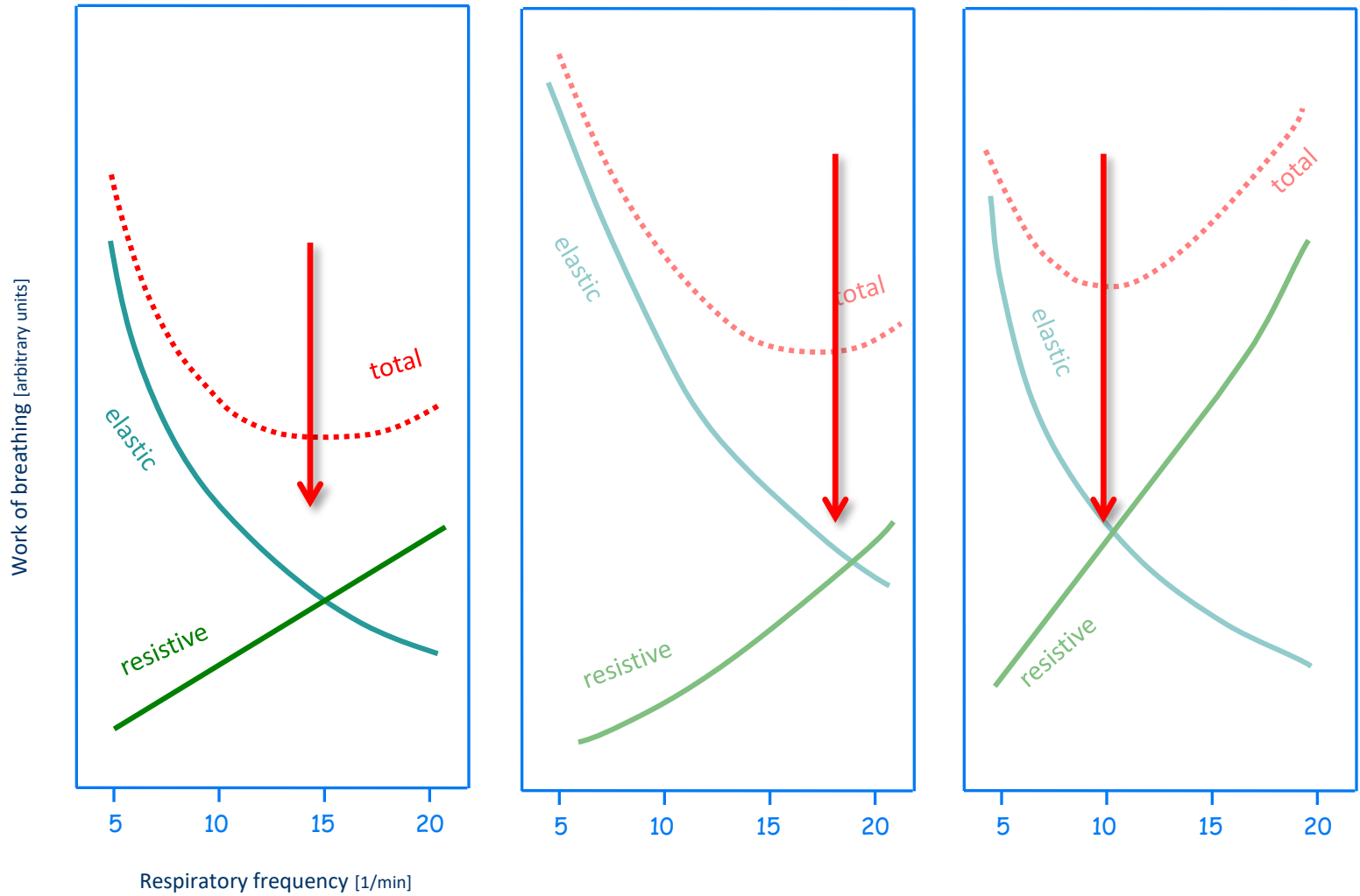
Nunn JF. Applied Respiratory Physiology 5th edition (2000)

Otis AB, et al. J App Physiol 1950;2:592-607.

NORMAL

INCREASED ELASTIC
RESISTANCE

INCREASED AIRFLOW
RESISTANCE



modified from:

Nunn JF. Applied Respiratory Physiology 3rd edition (1989)

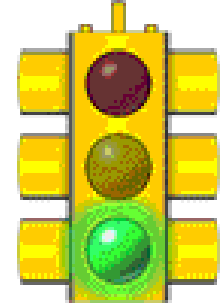
Kontrendikasyonlar

Kesin : Kaçak varsa...

- NIV
- Bronkoplevral fistül

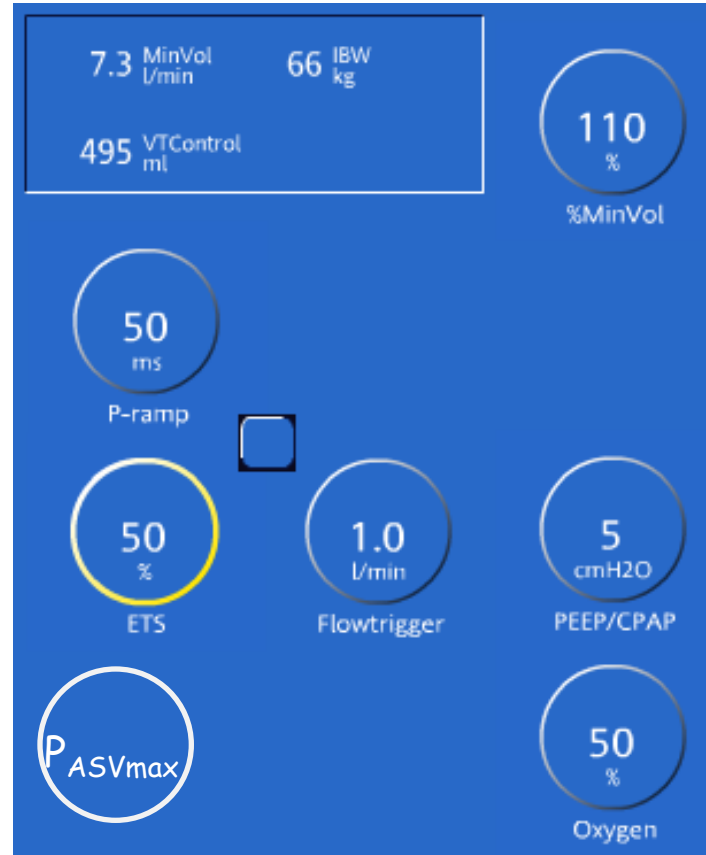
Rölatif:

- Cheynes Stokes solunumu



Başlangıç ayarları

- IBW : Boy ve cinsiyet
- %MV : % 100 veya % 110
- PEEP: manuel
- FiO_2 : PaO_2 ' ye göre
- Trigger sens: 2-3 l/min
- Rise time: 50 ms
- ETS: 25-40%
- P_{ASVmax} : 30 cmH₂O



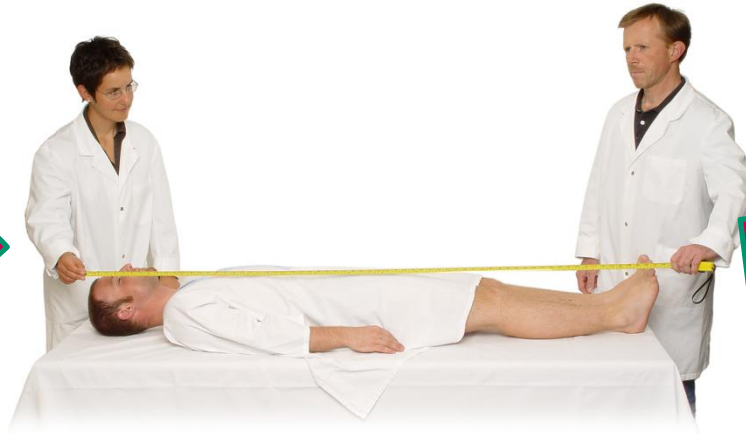
İnce ayarlar

Alarm ve limit

Ventilasyon

Oksijenizasyon

IBW ayarlamak



Ideal Body Weight IBW

Height in		IBW kg	
feet	meter	male	female
5'0"	1.52	50	46
5'1"	1.55	52	48
5'2"	1.57	55	50
5'3"	1.60	57	52
5'4"	1.62	59	55
5'5"	1.65	62	57
5'6"	1.67	64	59
5'7"	1.70	66	62
5'8"	1.72	68	64
5'9"	1.75	71	66
5'10"	1.77	73	69
5'11"	1.80	75	71
6'0"	1.82	78	73
6'1"	1.85	80	75
6'2"	1.88	82	78
6'3"	1.90	85	80
6'4"	1.93	87	82
6'5"	1.95	89	85
6'6"	1.98	91	87
6'7"	2.00	94	89

Source: Reynolds Medical Center
Hamilton Medical assumes no responsibility for the accuracy of data. Use of all information contained herein remains the responsibility of the physician.

HAMILTON MEDICAL
www.hamilton-medical.ch



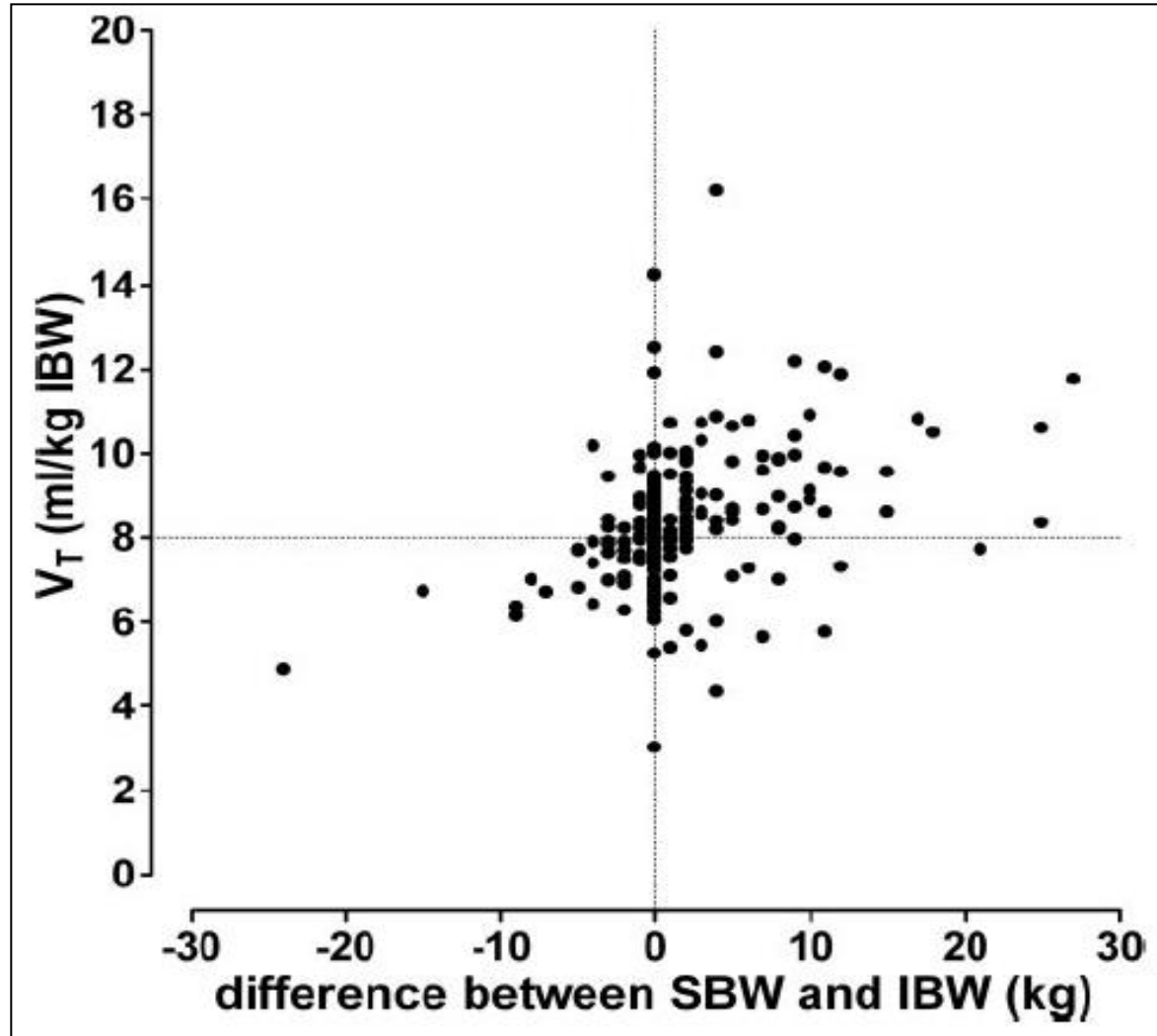
Gender

Male Female

170 cm Patient height

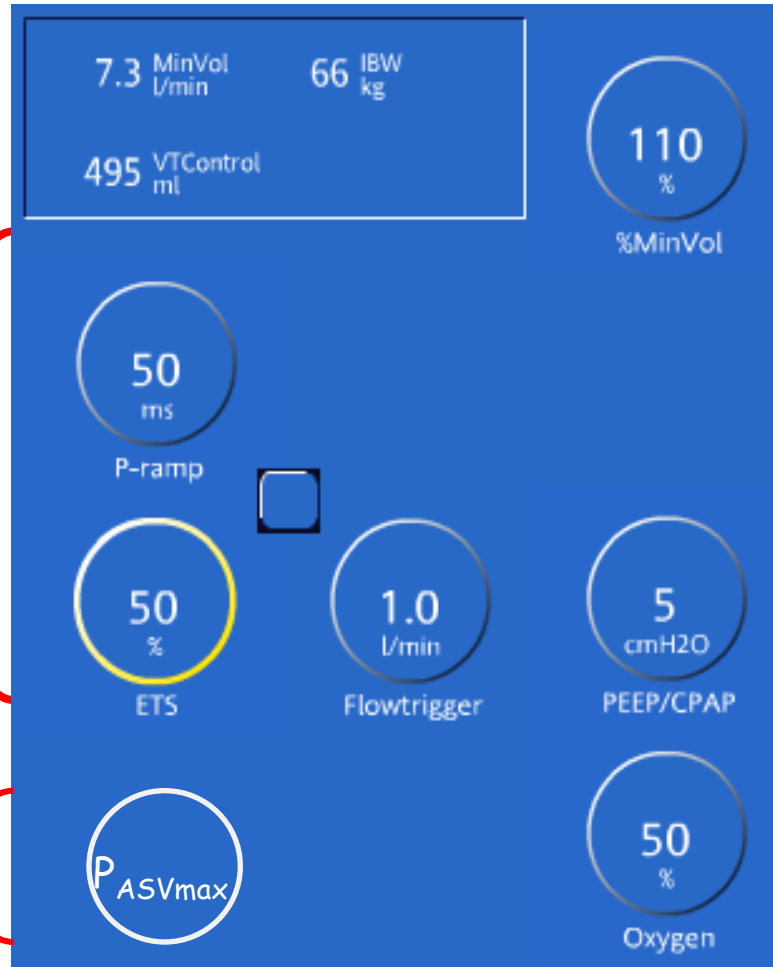
66 kg IBW

Doğru kilo !..



Pasif hastalarda ayarlar

Sabit



PaCO_2 ' ye göre %10 artır ya da azalt

Aktif değil

Hedefe ulaşmıyorsa artır

PaO_2 , P/V eğrisine göre ayarla

ASV Adult

28 Ppeak
cmH2O

6.6 ExpMinVol
l/min

515 VTE
ml

16 fTotal
b/min

Mode

Controls

100
%

25 350

%MinVol

5
cmH2O

0 50

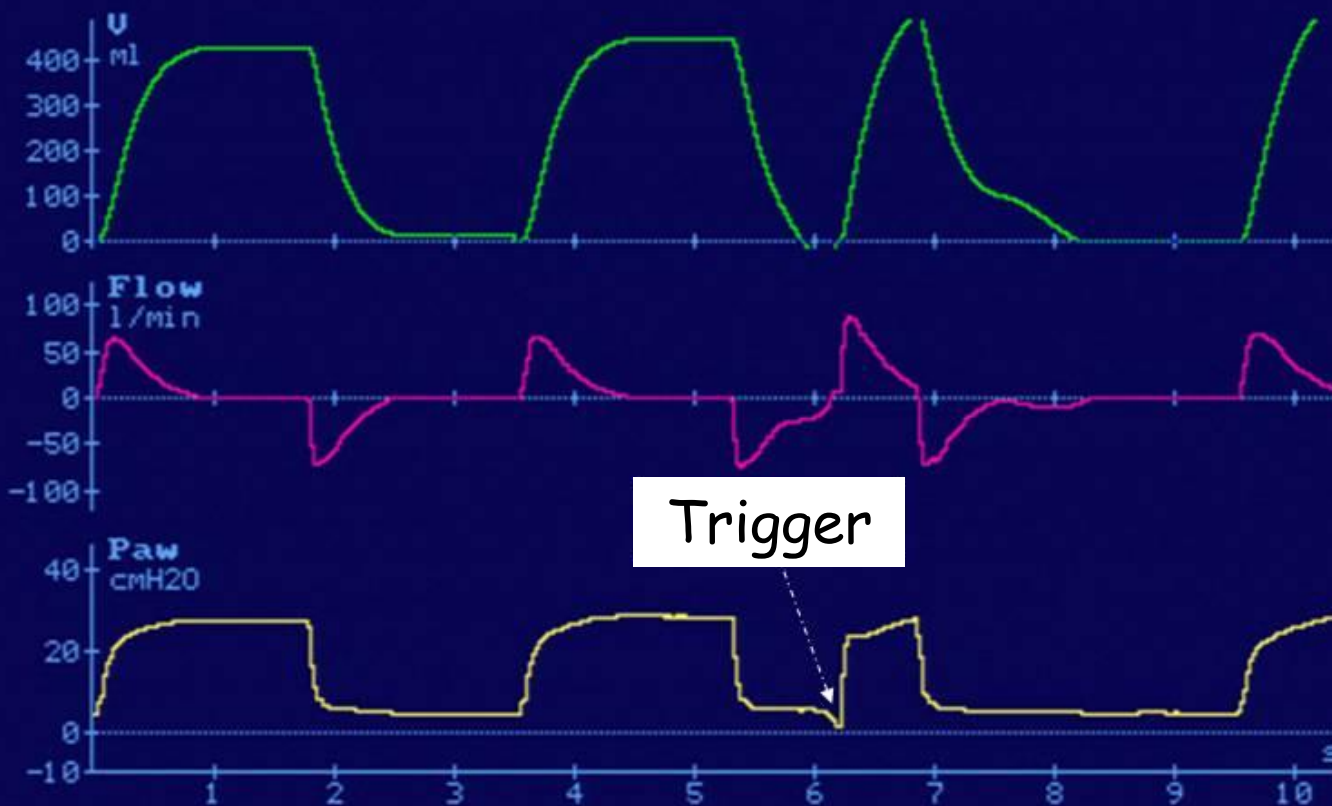
PEEP/CPAP

50
%

21 100

Oxygen

Alarms



TF 5514: Check loudspeaker

Aktif hastalarda ayarlar

Sabit



Senkronizasyona göre ayarla

Hedefe ulaşmıyorsa artır

Hasta eforu (SS, fizik bakı)' na göre % 20 artır/azalt

PaO₂' ye göre ayarla

Genel ayarlamalar

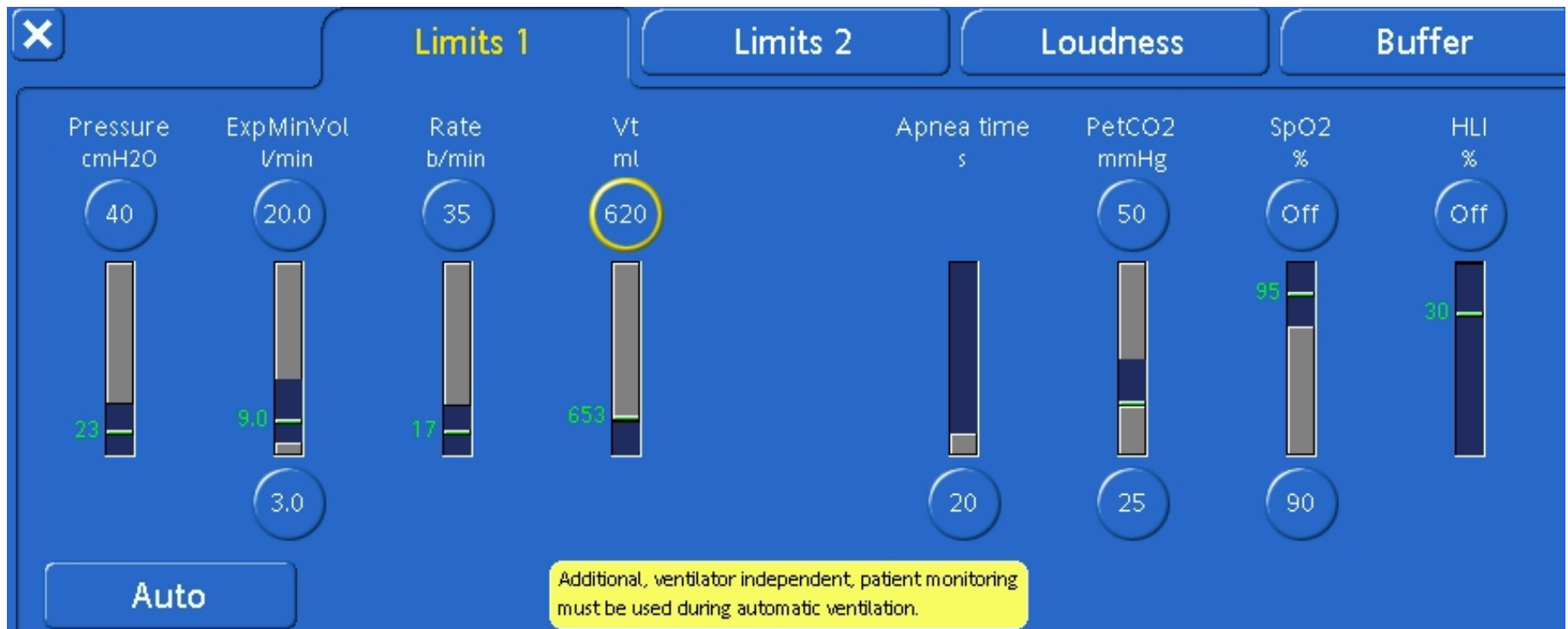
Pasif hastalar

	Normal lungs	COPD	ALI, ARDS	Chest wall stiffness	ARF
Days	357 (50%)	103 (14%)	108 (15%)	20 (3%)	129 (18%)
Patients	115	33	26	11	71
MV (%)	115 (100–130)	130 (110–150)	135 (115–150)	150 (130–170)	135 (110–160)
PEEP (cmH ₂ O)	5.0 (5.0–5.0)	5.0 (5.0–8.0)	9.5 (6.0–11.0)	5.0 (3.0–5.0)	5.0 (5.0–8.0)
V _T /PBW (ml/kg)	8.3 (7.7–9.1)	9.3 (8.2–10.8)	7.6 (6.7–8.8)	7.4 (6.2–8.2)	8.4 (7.8–8.9)

Aktif hastalar

	Normal lungs	COPD	ALI, ARDS	Chest wall stiffness	ARF
Days	333 (55%)	109 (18%)	25 (4%)	33 (5%)	110 (18%)
Patients	86	25	17	8	49
MV (%)	100 (100–120)	100 (100–120)	130 (110–137)	120 (100–150)	120 (100–140)
PEEP (cmH ₂ O)	5.0 (5.0–5.0)	5.0 (5.0–6.0)	8.0 (5.0–10.0)	5.0 (5.0–5.7)	5.0 (5.0–6.2)
V _T /PBW (ml/kg)	7.9 (7.3–8.8)	8.5 (7.7–9.5)	8.1 (6.7–8.8)	7.0 (6.0–7.8)	7.8 (7.1–8.5)

Alarm ayarları



Limits 1 Limits 2 Loudness Buffer

Parameter	Unit	Limit Value	Current Value
Pressure	cmH2O	40	23
ExpMinVol	l/min	20.0	9.0
Rate	b/min	35	17
Vt	ml	620	653
Apnea time	s	20	-
PetCO2	mmHg	50	25
SpO2	%	Off	95
HLI	%	Off	30

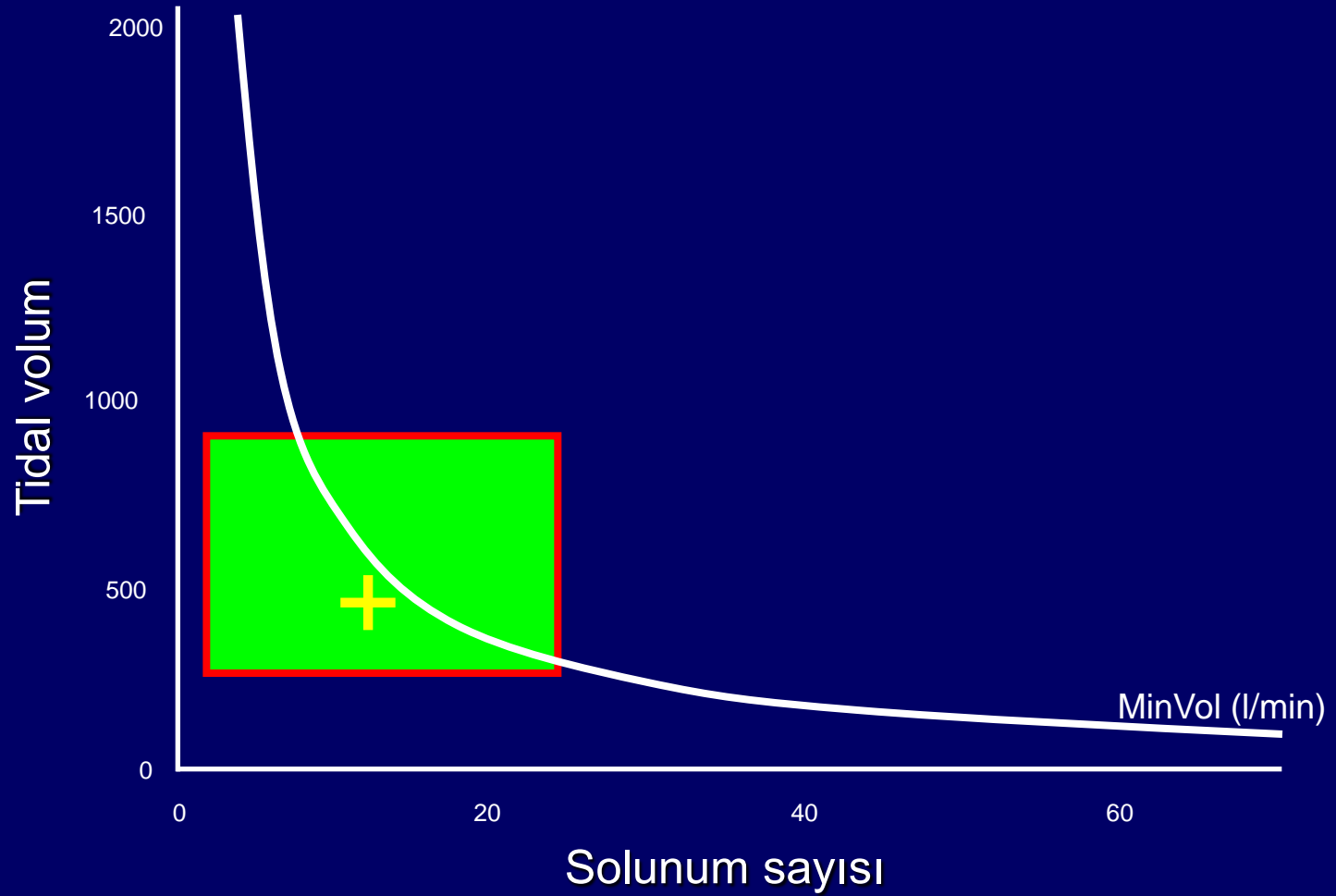
Auto

Additional, ventilator independent, patient monitoring must be used during automatic ventilation.

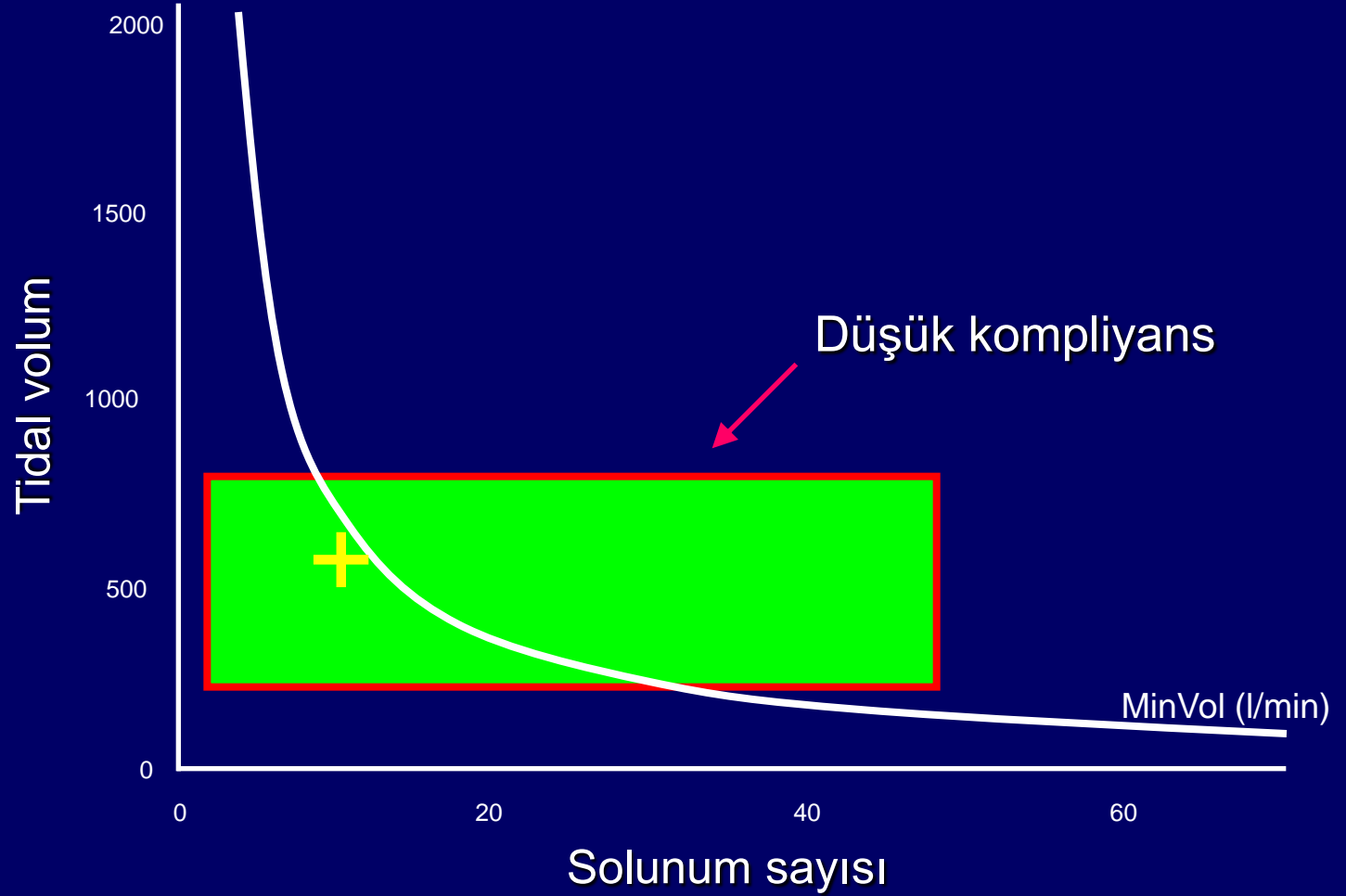
Monitörizasyon



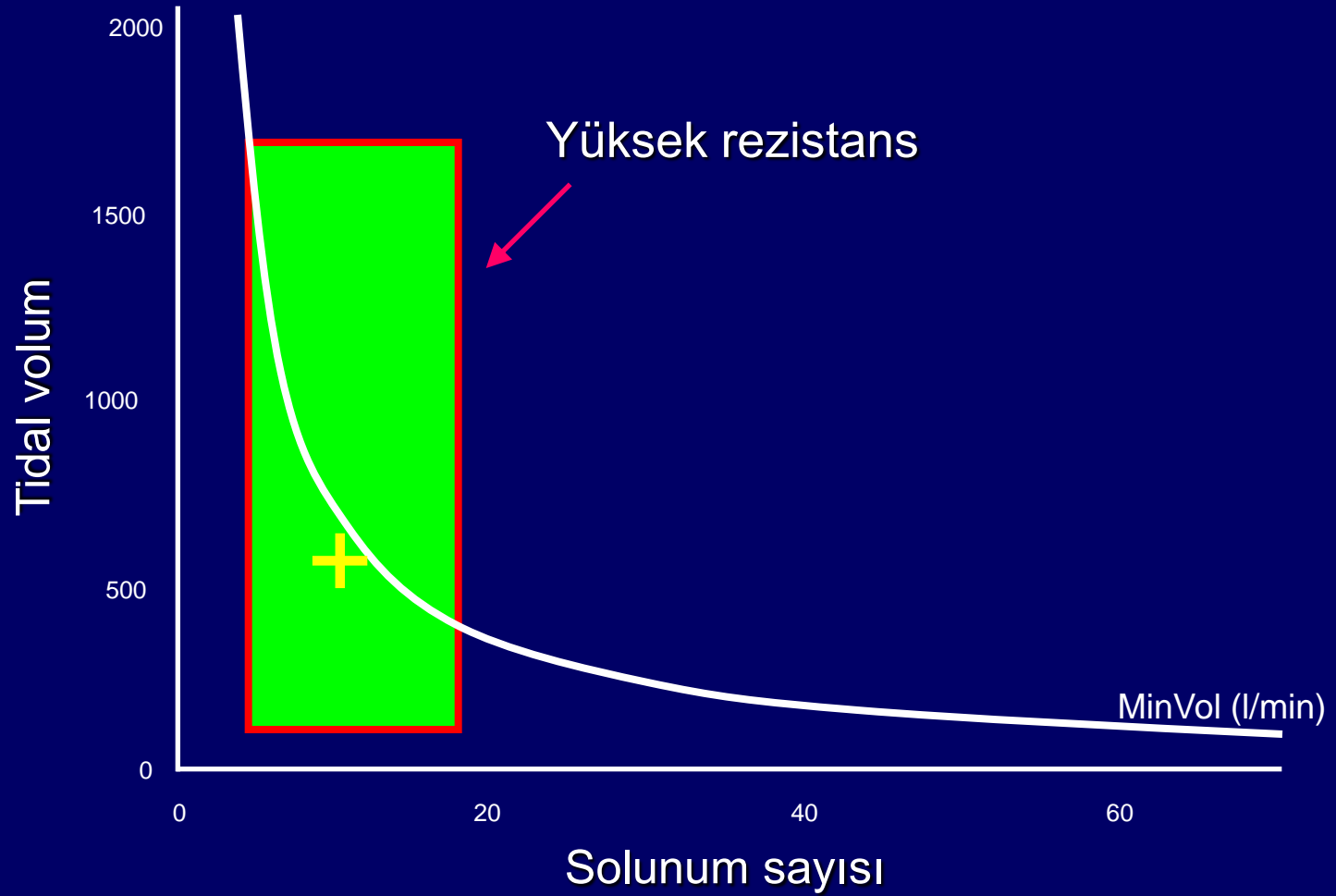
Monitörizasyon



Monitörizasyon



Monitörizasyon



ASV ile weaning

- Weaning kriterlerinin günlük gözlemi
- Weaning denemesi
- Ekstübasyon \pm NIV

Hemşireler

Weaninge hazırlık izlemi

Genel kriterler

- Sedasyon yok
- İnotrop/vazopresör yok
- Emirlerle uyuyor

Solunumsal kriterler

- $FiO_2 \leq 50\%$
- $PEEP \leq 5$ (8-10) cmH_2O
- Yeterli öksürük
- $Pinsp \leq 20$ cmH_2O



Weaning denemesi

ASV denemesi

- PEEP = 5 cmH₂O
- FiO₂ = 30%
- MV% = 25 %

10 dk sıkı izlem

30 dk sonunda ekstübasyon kararı

± NIV

ASV ile weaning

TABLE 2 Monitored respiratory data and arterial blood gases of extubated patients during the last 15 min of the weaning period

	ASV	PSV	p-value
Subjects n	40	39	
PS level	7 (6–8)	7 (7–7)	0.12
pH	7.41 (7.35–7.45)	7.39 (7.33–7.45)	0.54
P_{a,CO_2} mmHg	56 (51–64)	57 (50–66)	0.62
HCO_3 mmol·L ⁻¹	36 (35–40)	36 (29–40)	0.6
$P_{a,O_2}/F_{i,O_2}$	288 (230–310)	267 (230–297)	0.46
$V'E$ L·min ⁻¹	8.3 (7.4–9.1)	8.4 (6.9–9.8)	0.87
$V'E$ mL·kg ⁻¹	119 (101–148)	126 (103–133)	0.91
V_T mL	394 (333–489)	424 (326–474)	0.74
V_T mL·kg ⁻¹	5.7 (5.3–6.3)	5.4 (4.9–6.9)	0.45
Respiratory rate breaths·min ⁻¹	22 (17–26)	23 (20–27)	0.43
RC_{exp} s	0.9 (0.7–1.1)	0.8 (0.7–0.9)	0.37
tE s	1.9 (1.5–2.5)	1.7 (1.4–2)	0.16
tI s	0.8 (0.7–1.2)	0.9 (0.8–1)	0.81
$P_{0.1}$ cmH ₂ O	2.8 (1.1–3.9)	2.3 (2–3.4)	0.57

ASV

A Randomized Controlled Trial Comparing the Ventilation Duration Between Adaptive Support Ventilation and Pressure Assist/Control Ventilation in Medical Patients in the ICU

Cenk Kirakli, MD; Ilknur Naz, PT, MS; Ozlem Ediboglu, MD; Dursun Tatar, MD; Ahmet Budak, MD; and Emel Tellioglu, MD

CHEST 2015; 147(6):1-7

TABLE 1] Baseline Characteristics of the Two Groups at the Time of Inclusion

Variable	ASV (n = 114)	P-ACV (n = 115)
Age, y	70 (61-79)	73 (63-80)
Male sex	78 (68)	77 (67)
APACHE II	22 (18-26)	22 (18-25)
FEV ₁ , L	1.02 (0.58-1.55)	0.84 (0.68-0.97)
FVC, L	1.74 (1.01-2.01)	1.34 (1.19-1.83)
FEV ₁ /FVC, %	71 (52-81)	64 (43-82)
pH	7.24 (7.16-7.32)	7.23 (7.16-7.33)
Paco ₂ , mm Hg	82 (58-99)	75 (52-95)
Pao ₂ /Fio ₂	159 (114-216)	153 (120-213)
Total amount of midazolam, mg/patient	5 (0-30)	5 (0-35)
Total amount of fentanyl, µg/patient	0 (0-20)	0 (0-25)
Cause of MV		
COPD	73	59
Cardiac	10	13
Pneumonia	11	16
Cerebrovascular	7	14
Restrictive	5	5
Sepsis	3	3
Malignancy	3	4
Obesity-hypoventilation	2	1

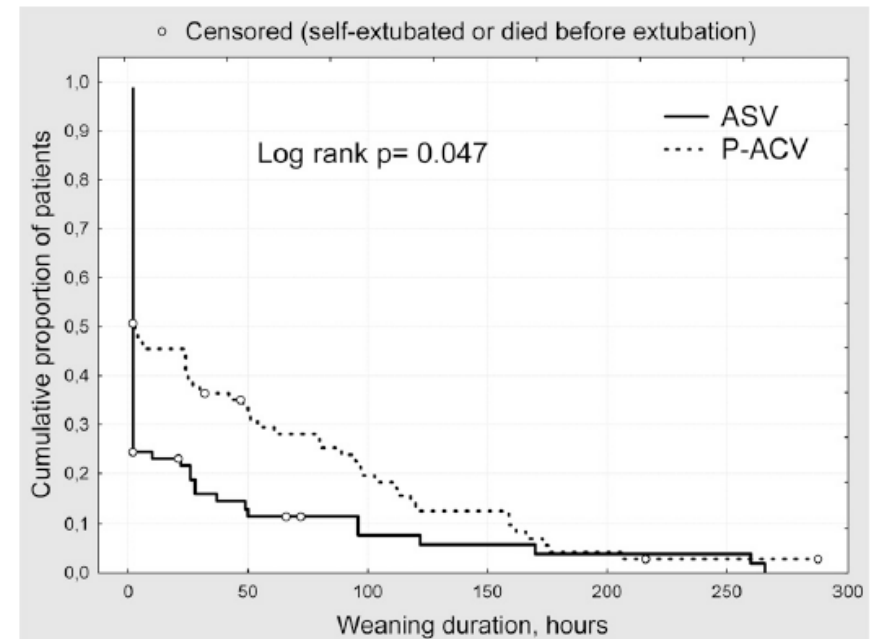
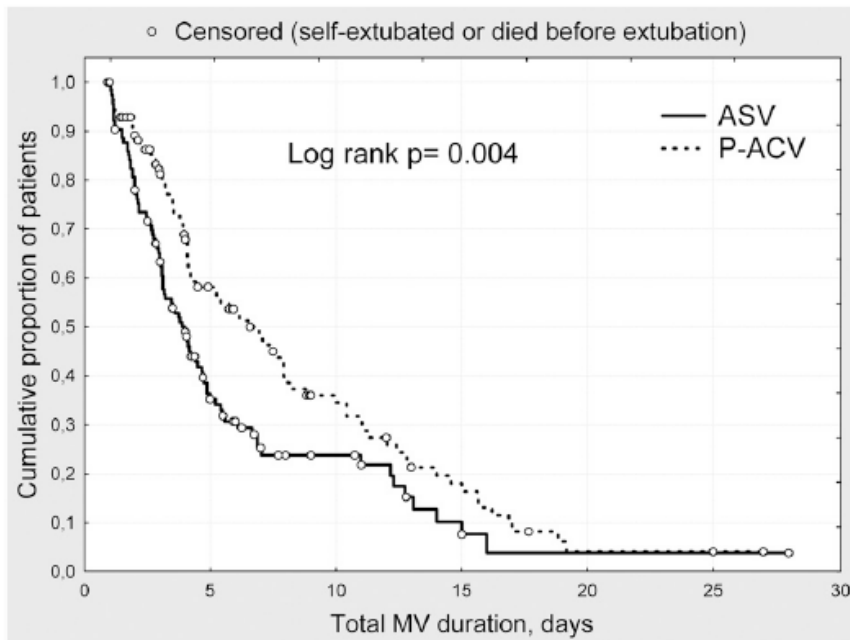
Data are presented as median (interquartile range), No. (%), or No. Respiratory function tests are for the patients with obstructive and restrictive lung disease only. Arterial blood gas results are the ones just before intubation. APACHE = Acute Physiologic and Chronic Health Evaluation; ASV = adaptive support ventilation; MV = mechanical ventilation; P-ACV = pressure assist/control ventilation.

ASV

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CHEST 2015; 147(6):1-7

TABLE 2] Comparison of ASV and Conventional Ventilation Groups

Outcome	ASV (n=114)	P-ACV (n=115)	P Value
MV duration until weaning, h	67 (43-94)	92 (61-165)	.003
Mean ± SD	(84 ± 77)	(126 ± 102)	.004
Weaning duration, h	2 (2-2)	2 (2-80)	.001
Mean ± SD	(20 ± 49)	(44 ± 64)	.017
Total MV duration, d	4 (2-6)	4 (3-9)	.016
Mean ± SD	(5 ± 4)	(6 ± 5)	.008
Total No. manual settings per patient	2 (1-2)	3 (2-5)	<.001
LOS in the ICU, d	7 (4-11)	8 (5-13)	.19
Intubation-free days at day 28	23 (1-25)		
Mortality at day 28	46 (40)		
Self-extubation	11 (9)		
VAP	8 (7)		

Data are presented as No. (%) or median (IQR). Mean ± SD is also presented for some variables. LOS = length of stay; VAP = ventilator-associated pneumonia. See Table 1 legend for expansion.

TABLE 3] Weaning Status of the Two Groups

Weaning Status	ASV	P-ACV	P Value
Success	64 (56) ^a	54 (47) ^b	.06
Failure	14 (12) ^a	25 (22) ^b	...
Nonweaned	36 (32) ^a	36 (31) ^b	...
Simple	63 (81) ^c	44 (56) ^d	.001 ^e
Difficult	12 (15) ^c	30 (38) ^d	...
Prolonged	3 (4) ^c	5 (6) ^d	...

IntelliVent-ASV

- EtCO₂ değerine göre ASV
 - PS düzeyi
 - V_T
 - SS
- SpO₂ değerine göre PEEP+FiO₂
- "Quickwean" ve otomatik "SBT" fonksiyonu

Jean-Michel Arnal
Marc Wysocki
Dominik Novotni
Didier Demory
Ricardo Lopez
Stéphane Donati
Isabelle Granier
Gaëlle Corno
Jacques Durand-Gasselín

Safety and efficacy of a fully closed-loop control ventilation (IntelliVent-ASV®) in sedated ICU patients with acute respiratory failure: a prospective randomized crossover study



IntelliVent-ASV

- Randomize-crossover çalışma
- ASV vs IntelliVent-ASV
- 2 saatlik uygulamalar
- Güvenlik ve etkinlik

Table 1 Baseline characteristics of the study population and lung condition at inclusion

Parameter	Value
Sex ratio (M/F)	32/18
Age (years)	65 ± 16
Predicted body weight (kg)	62 ± 12
SAPS II	50 ± 18
Mechanical ventilation duration before inclusion (days)	2 ± 2
Lung condition at inclusion, <i>n</i> (%)	
Normal lungs	19 (38)
Coma: stroke, head trauma, meningitidis...	12 (24)
Sepsis	7 (14)
ALI/ARDS	31 (62)
Pulmonary injury: pneumonia, aspiration, chest trauma...	20 (40)
Extra-pulmonary injury: septic shock, pancreatitis, TRALI	11 (22)

TRALI transfusion-related acute lung injury

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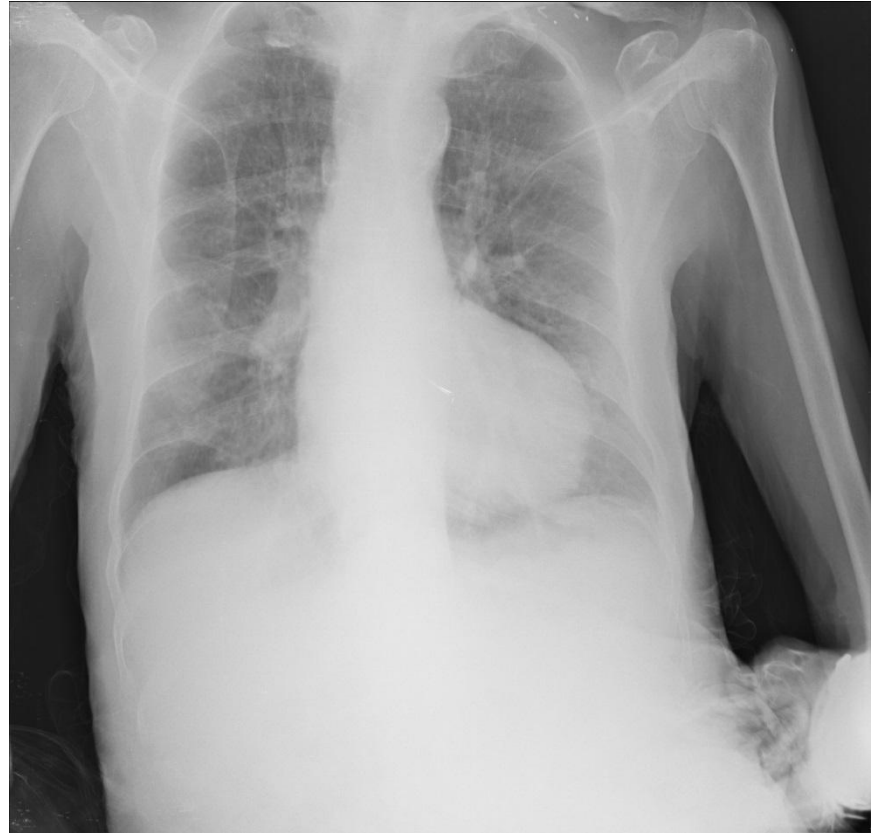


IntelliVent-ASV

Parameter	ASV	IntelliVent-ASV®	<i>p</i>
MV (L/min)	7.6 (6.5–9.5)	6.8 (6.0–8.0)	<0.001
V_T /PBW (mL/kg)	8.3 (7.8–9.0)	8.1 (7.7–8.6)	0.003
RR (breath/min)	15 (14–17)	14 (13–17)	0.004
P_{INSP} (cmH ₂ O)	28 (24–33)	25 (22–29)	<0.001
P_{PLAT} (cmH ₂ O)	24 (20–29)	20 (19–25)	0.005
PEEP (cmH ₂ O)	10 (6–14)	8 (5–10)	0.011
FiO ₂ (%)	40 (30–50)	30 (30–39)	<0.001
C_{STAT} (mL/cmH ₂ O)	37 (31–48)	37 (29–44)	0.935
R_{INS} (cmH ₂ O s/L)	16 (14–18)	17 (14–19)	0.699
RC_{EXP} (s)	0.7 (0.6–0.8)	0.7 (0.6–0.8)	0.326
pH	7.3 (7.3–7.4)	7.3 (7.2–7.4)	0.104
PaO ₂ (mmHg)	92 (81–124)	84 (75–104)	0.052
PaO ₂ /FiO ₂ (mmHg)	240 (163–318)	259 (197–323)	0.117
PaCO ₂ (mmHg)	37 (34–42)	37 (33–49)	0.026
SaO ₂ (%)	97 (95–98)	96 (93–98)	0.028
Dead space (mL)	144 (99–224)	134 (85–209)	0.009
CO ₂ gradient (mmHg)	11 (7–18)	11 (6–18)	0.874

Olgu

- 67 y/ E
- AECOPD
- 1 saat NIV
 - pH: 7.06
 - PaO₂: 86 mmHg
 - PaCO₂: 123 mmHg
 - HCO₃: 22
 - SaO₂: 91%
 - PaO₂/FiO₂: 215



Olgu

- AKG (2 saat Intellivent ASV)
 - pH: 7.36
 - PaCO₂: 65 mmHg
 - PaO₂: 143 mmHg
 - HCO₃: 33 mmol
 - SaO₂: 99%

Olgu

- AKG (SBT öncesi)
 - pH: 7.41
 - PaCO₂: 46 mmHg
 - PaO₂: 66 mmHg
 - HCO₃: 29 mmol
 - SaO₂: 93%
- SBT başarılı - EKSTÜBASYON

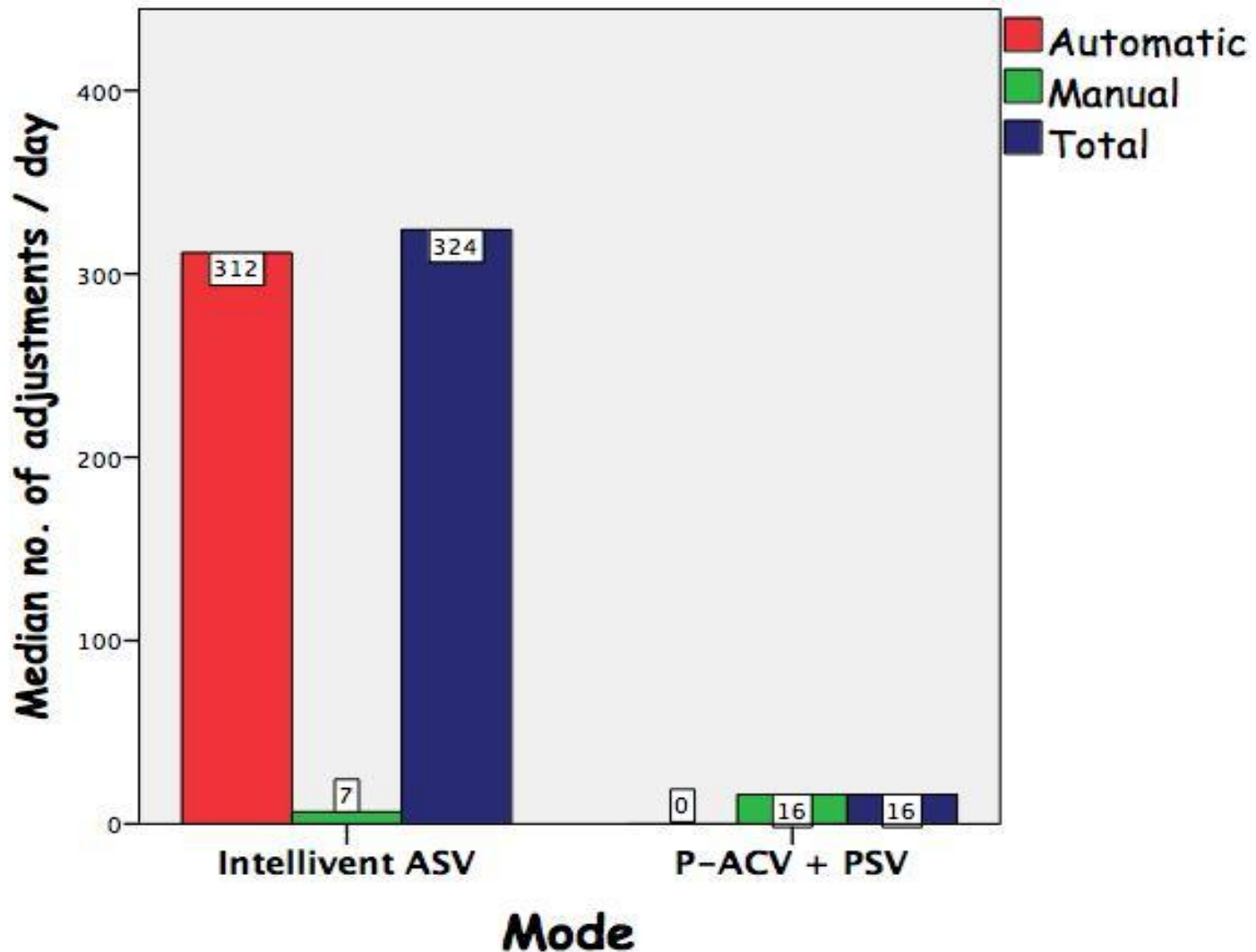
Olgu

- Total MV süresi: 29.4 saat
 - Pasif : 0.08 saat
 - 99 % hasta tetikliyor
- Quickwean aktivasyonu: 1.81 saat
- Weaning süresi: 28 saat
(Quickwean akt. dan ekstübasyona kadar geçen süre)
- Manuel ayar sayısı: 2

Olgu

- Otomatik ayar sayısı :
 - MinVol % : 235 (8/saat)
 - FiO₂ : 34 (1.16/saat)
 - TOPLAM : 269
- 10 saat NIV
- YB günü : 4 gün
- Hastane günü : 5 gün

Ayar sayıları (KOAH, Yayınlanmamış veri)



Hemşireler açısından

- Tek mod
- Hasta durumuna adaptasyon
- Uyum daha iyi
- Daha az alarm
- Konforlu
- Daha az sedasyon
- Güvenilir



Doktorlar açısından



- Bakımda homojenite
- İşyükünde azalma
- Daha az sedasyon
- Weaning süresinde azalma
- Ventilatör idaresinde kolaylık
- Tedavi organizasyonunda gelişme
- Bilgide artış

Sonuç

- ASV: kapalı halka ventilasyon
- Fizyolojiye dayanan algoritma
- Girdi: Ekspiratuar zaman sabiti
- Ayarlamak kolay
- Monitörizasyon konvansiyonel
- Kontrendikasyonlarda ve karmaşık solunum mekaniklerinde dikkat !...



Teşekkürler...



ANASAYFA DAVET KURULLAR GENEL BİLGİLER KAYIT-KONAKLAMA BİLİMSEL PROGRAM BİLDİRİ ÖZETLERİ İLETİŞİM EN

15. ULUSAL DAHİLİ VE CERRAHİ BİLİMLER YOĞUN BAKIM KONGRESİ 7. AVRASYA YOĞUN BAKIM TOPLANTISI

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