
PHYSICAL MEDICINE & REHABILITATION
New Jersey
Medical School
UMD
NEW JERSEY


BONUS
25% More


adidas


BONUS
25% More

The Respiratory Muscles

- Inspiratory
- Expiratory
- Bulbar-innervated

- The inspiratory and expiratory muscle aids

COPD/Sleep disordered breathing

- PFTs – diffusion, ABGs, plethysmography, forced expiratory volumes/ polysomnography
- Bronchodilators and oxygen therapy/CPAP or low span BiPAP

MOST COMMON ERRORS

MISS INTERPRETATION OF SYMPTOMS

INADEQUATE PFTs

FAILURE TO MONITOR SLEEP

OVER RELIANCE ON ABGs

OVER RELIANCE ON TRACHEOSTOMY

OVER RELIANCE ON SUCTIONING

OXYGEN THERAPY

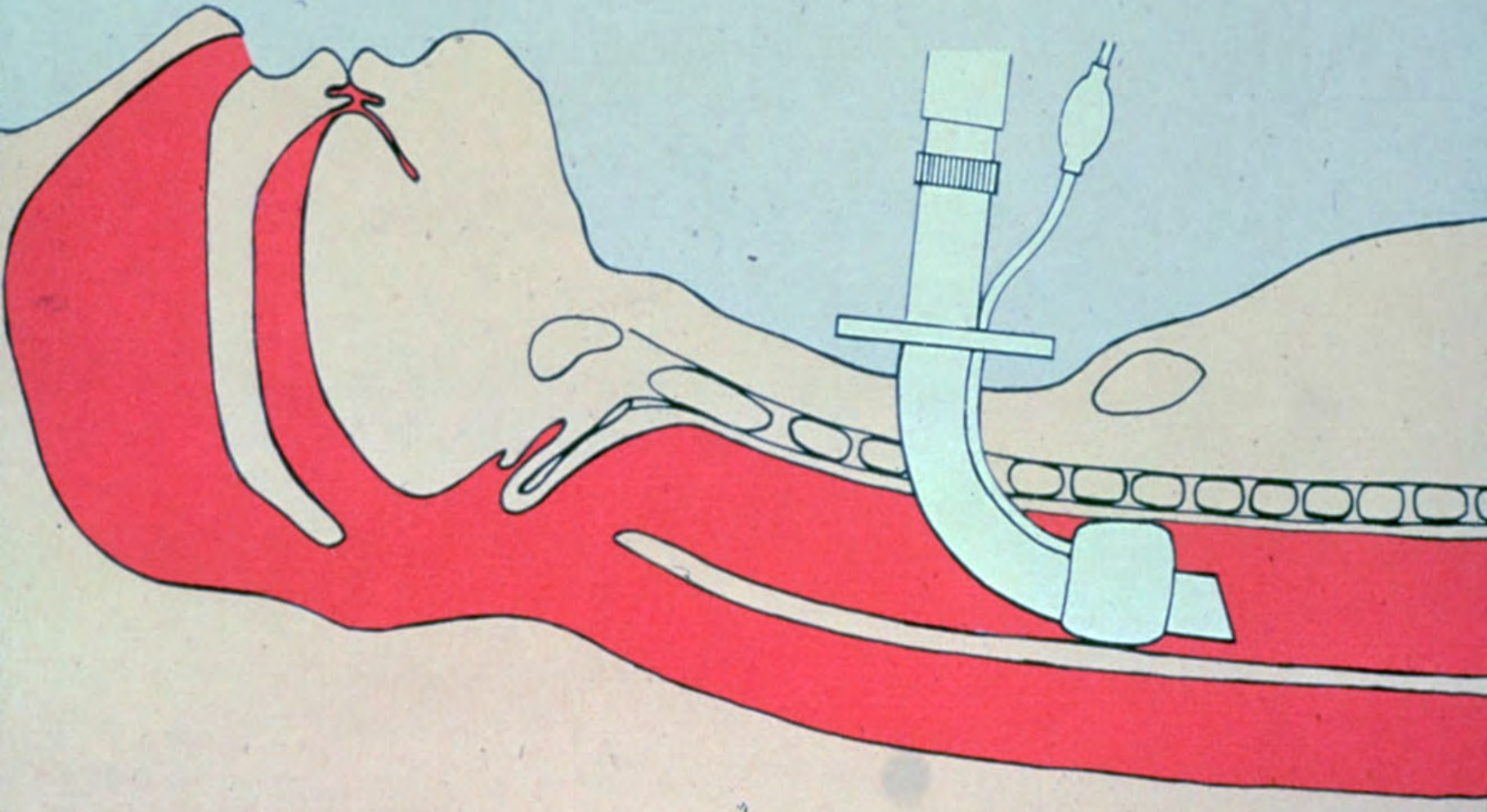
SYMPTOMS OF CHRONIC HYPOXIA

Dyspnea
Cognitive changes
Anxiety
Personality changes
Sequelae of hypertension

Symptoms of Chronic Alveolar Hypoventilation

frequent hospital admissions for SOB,
atelectasis, pneumonia
O2, CPAP treatments without benefit
morning headaches, fatigue, SOB
daytime drowsiness (hypersomnolence)
frequent awakening at night, esp. with
SOB, tachycardia, frequency, enuresis
difficulty falling asleep and awaking in AM
nightmares (especially respiratory)
loss of concentration, memory
fall off in grades, intellect, injuries
anxiety, personality changes
weight change, difficulty with secretions
hx. of CHF, hypertension, nausea

TRACHEOSTOMY



Pulmonary Function and Aging

Normal: VC 30cc/yr after 19
FEV1 30cc/yr after 19 (1-1.2%)
MVV 0.8%/yr after 30
$PaO_2 = 109 - 0.43$ (age)

Loss of Volumes doubled in COPD
Variable in neuromuscular disease

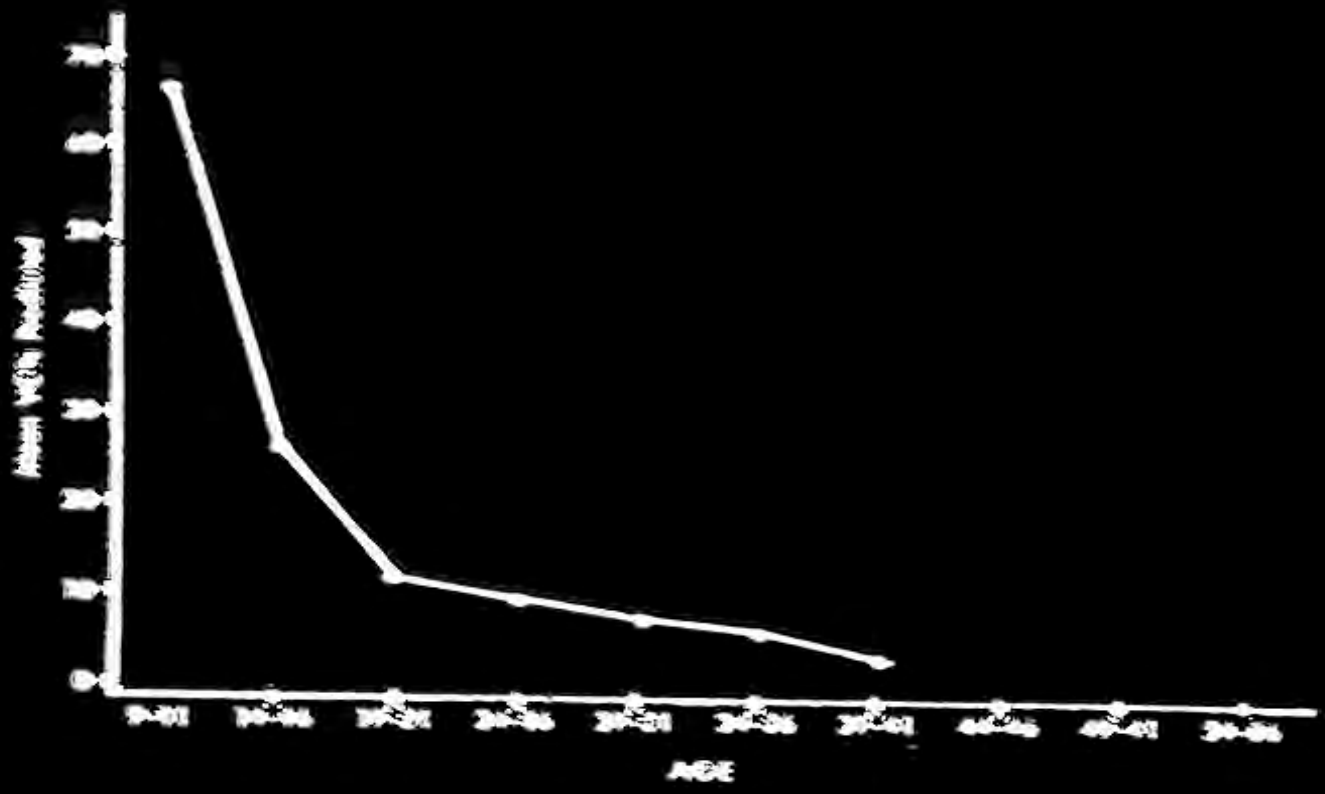
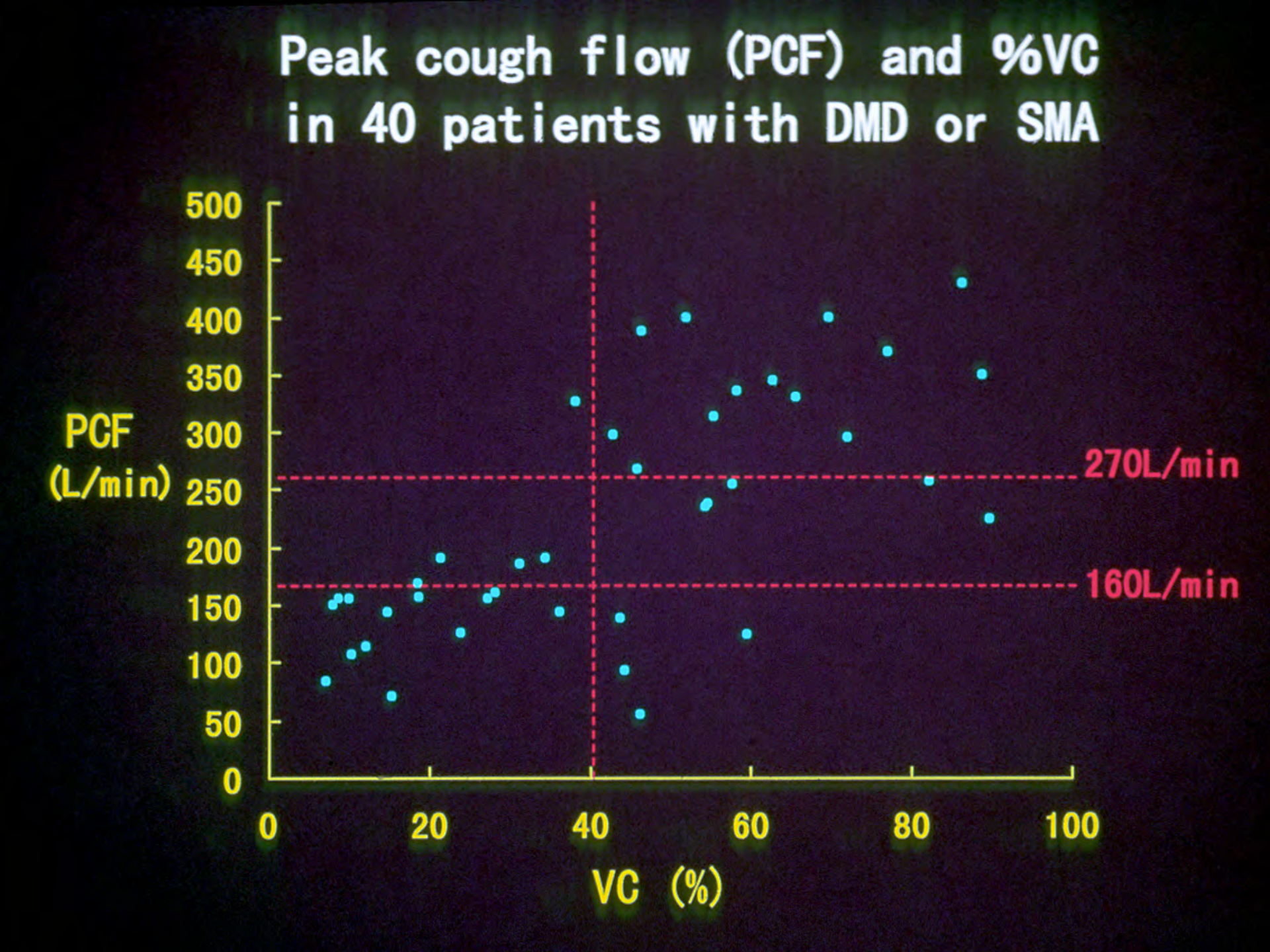
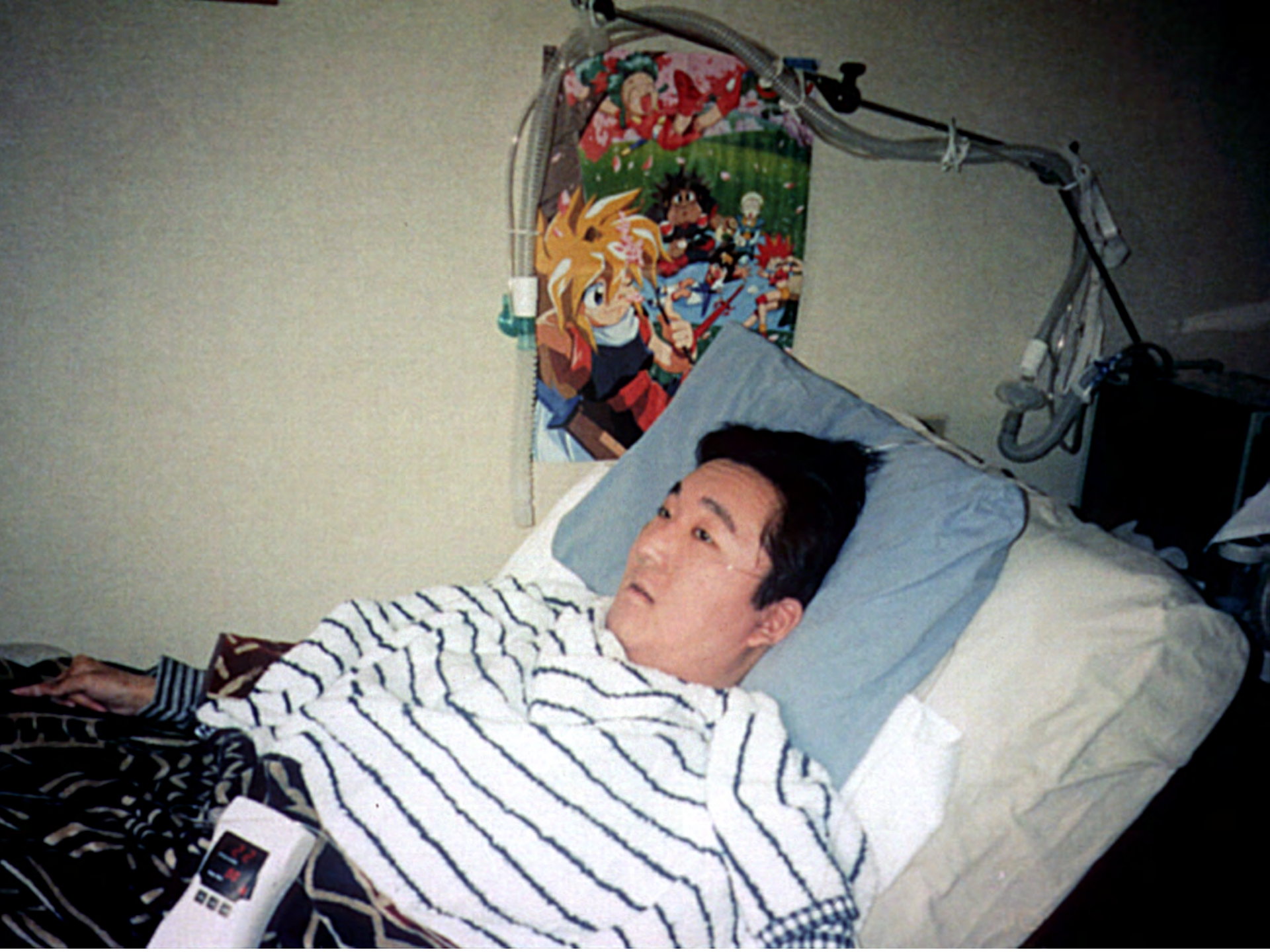


Fig 2—Deterioration of vital capacity as a function of age.

Bach J, Alba A, Pilkington LA, Lee M, Longterm Rehab. In Advanced Staged Childhood Onset, Rapidly Pro. Mus. Dys, Arch Phys Med Rehabil Vol 62, July 1981


Peak cough flow (PCF) and %VC
in 40 patients with DMD or SMA
PCF
(L/min)
500
450
400
350
300
250
200
150
100
50
0
270L/min
160L/min
0
20
40
60
80
100
VC (%)




SaO2%
Pulse


HALOSCALE
STANDARD
Wright Respirometer
LITRES

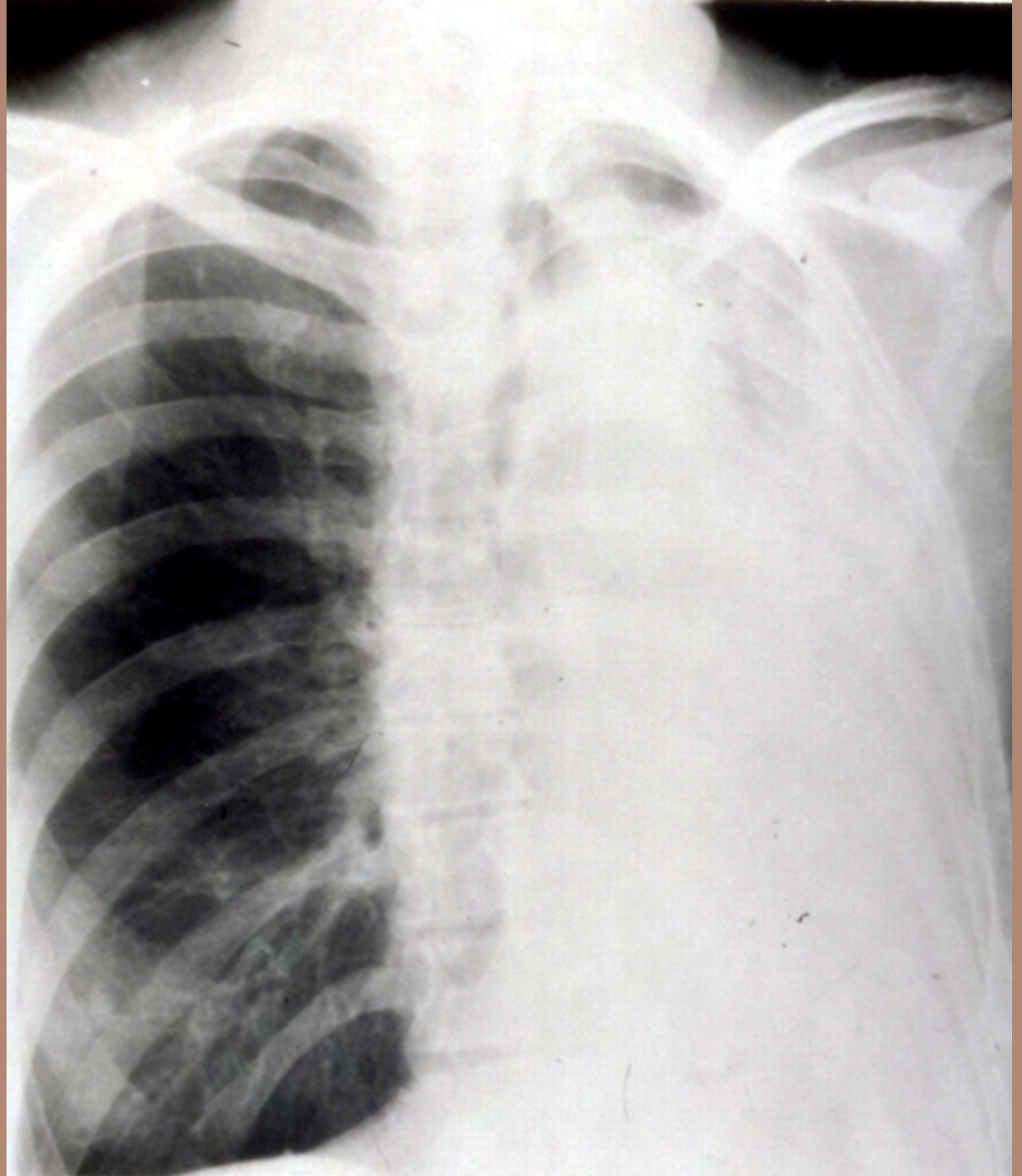
Treatment Goals

- Optimize chest wall/lung ROM and growth
- Optimize cough flows
- Maintain normal ventilation

Optimize Cough Flows and Airway Secretion Elimination

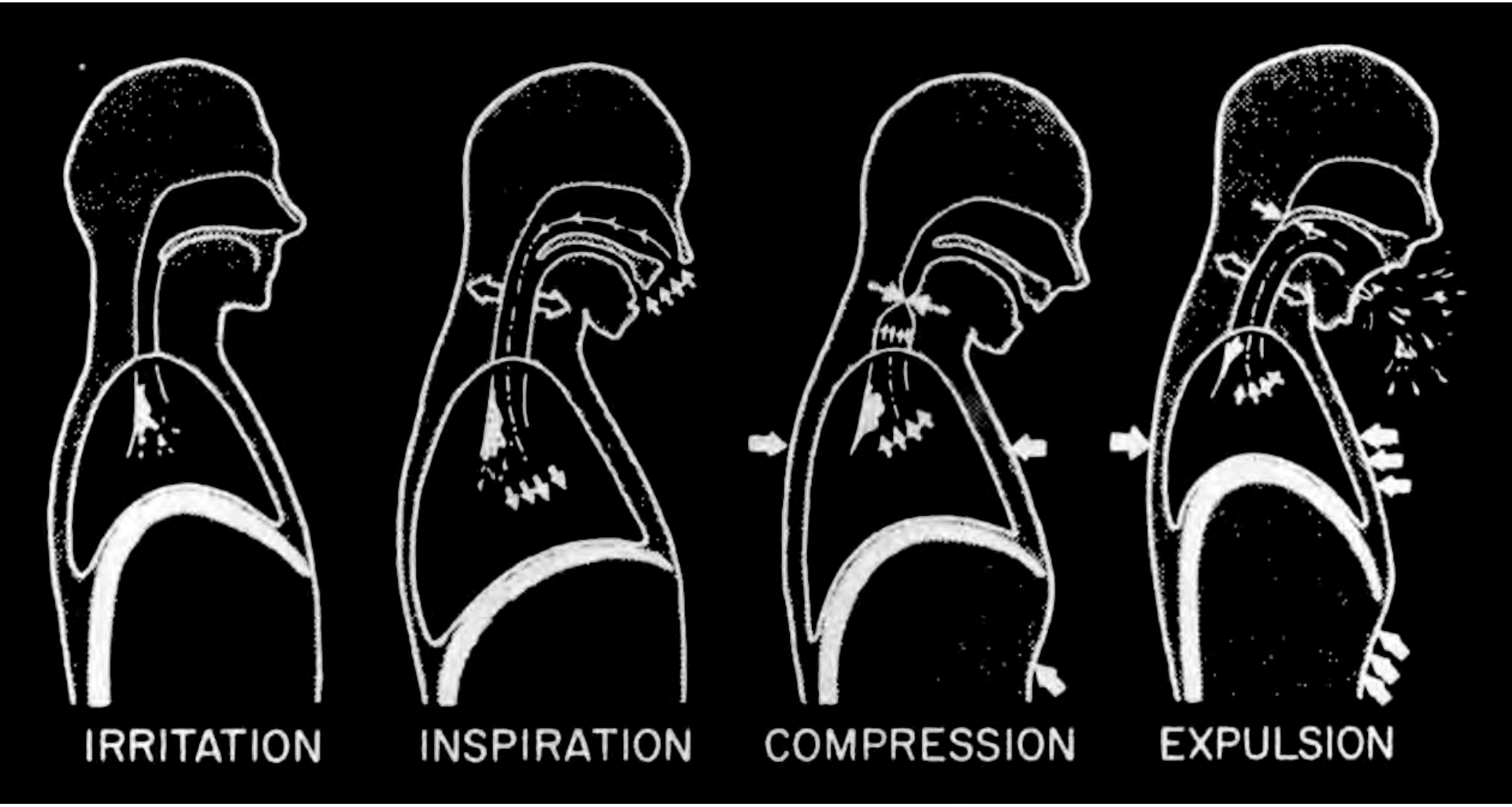
Mucus plugging is the primary cause of pneumonia, lung collapse, failure to wean, obstructive emphysema.(1)
It simulates pulmonary embolism.(2)

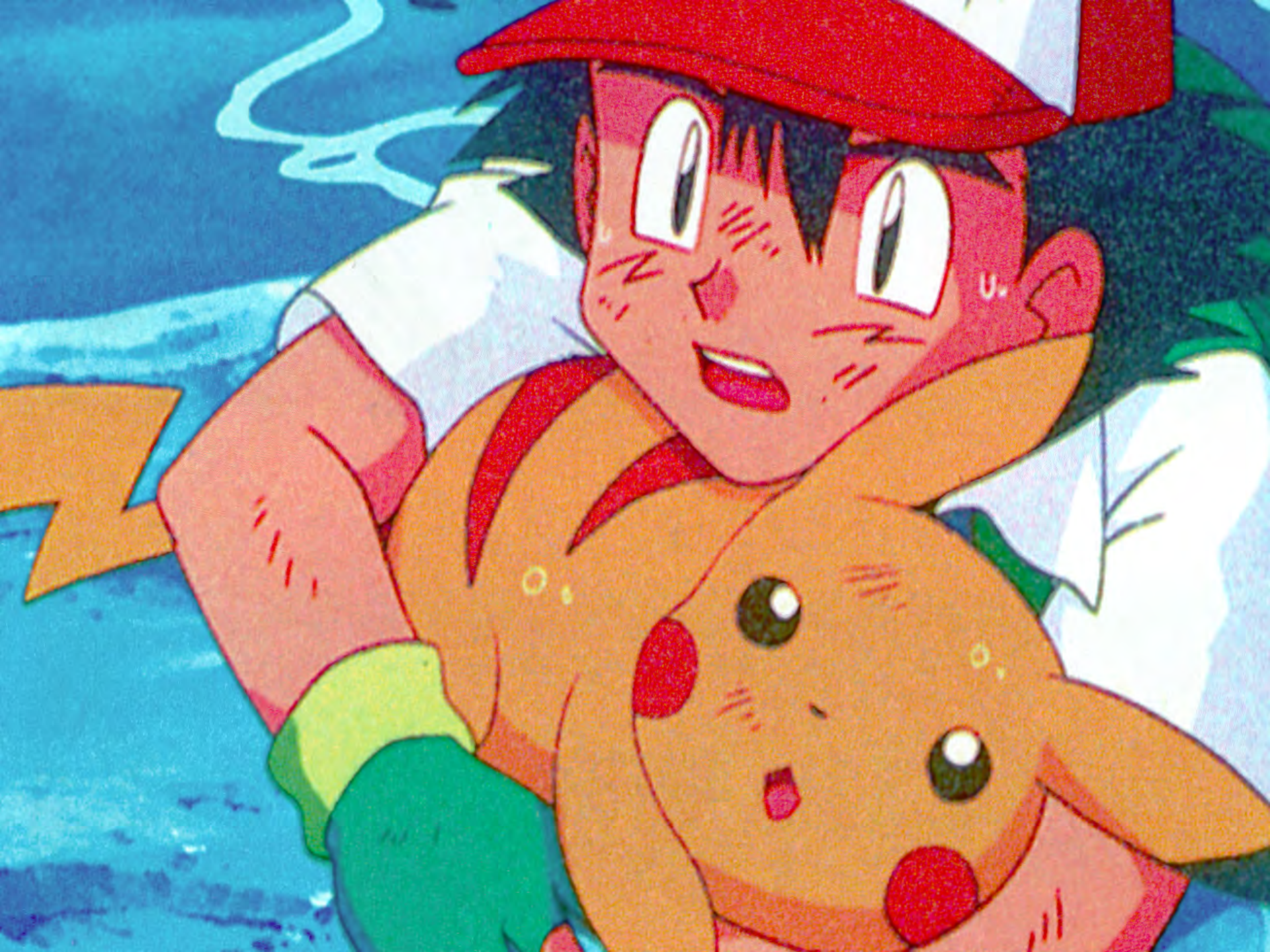
Cohn et al. Arch Phys Med Rehabil 1987:68.
Dee et al. Chest 1984:85.



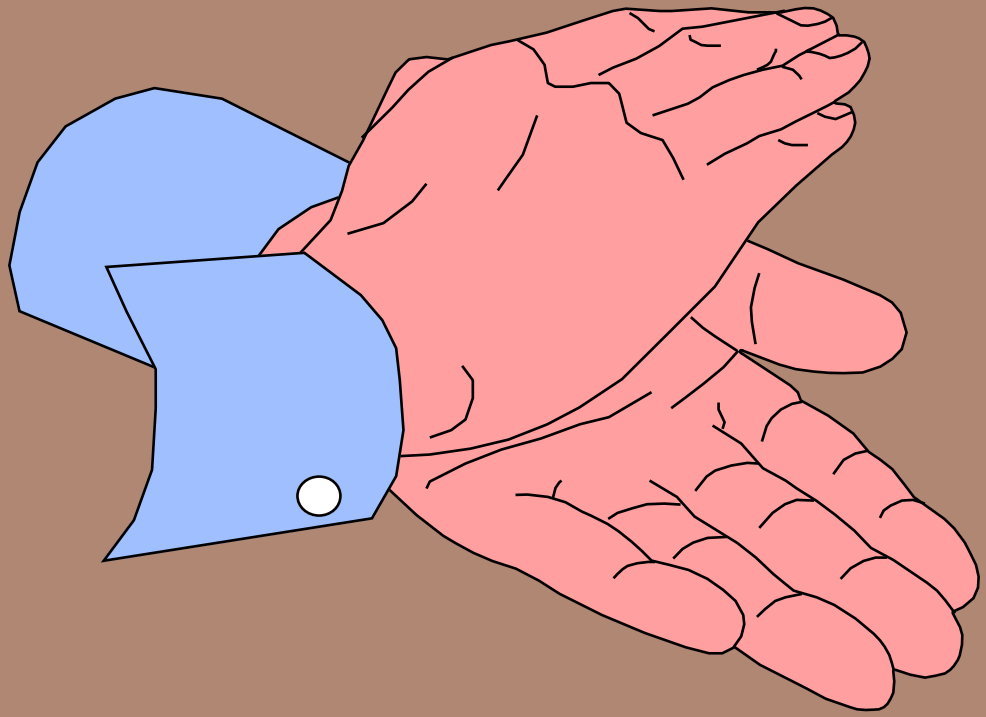
Up to 90% of mortality in Duchenne muscular dystrophy and episodes of respiratory failure are triggered by chest colds

Bach JR et. Neuromuscular ventilatory insufficiency: the effect of home mechanical ventilation vs. oxygen therapy on pneumonia and hospitalization rates. Am J Phys Med Rehabil 1998;77:8-19.

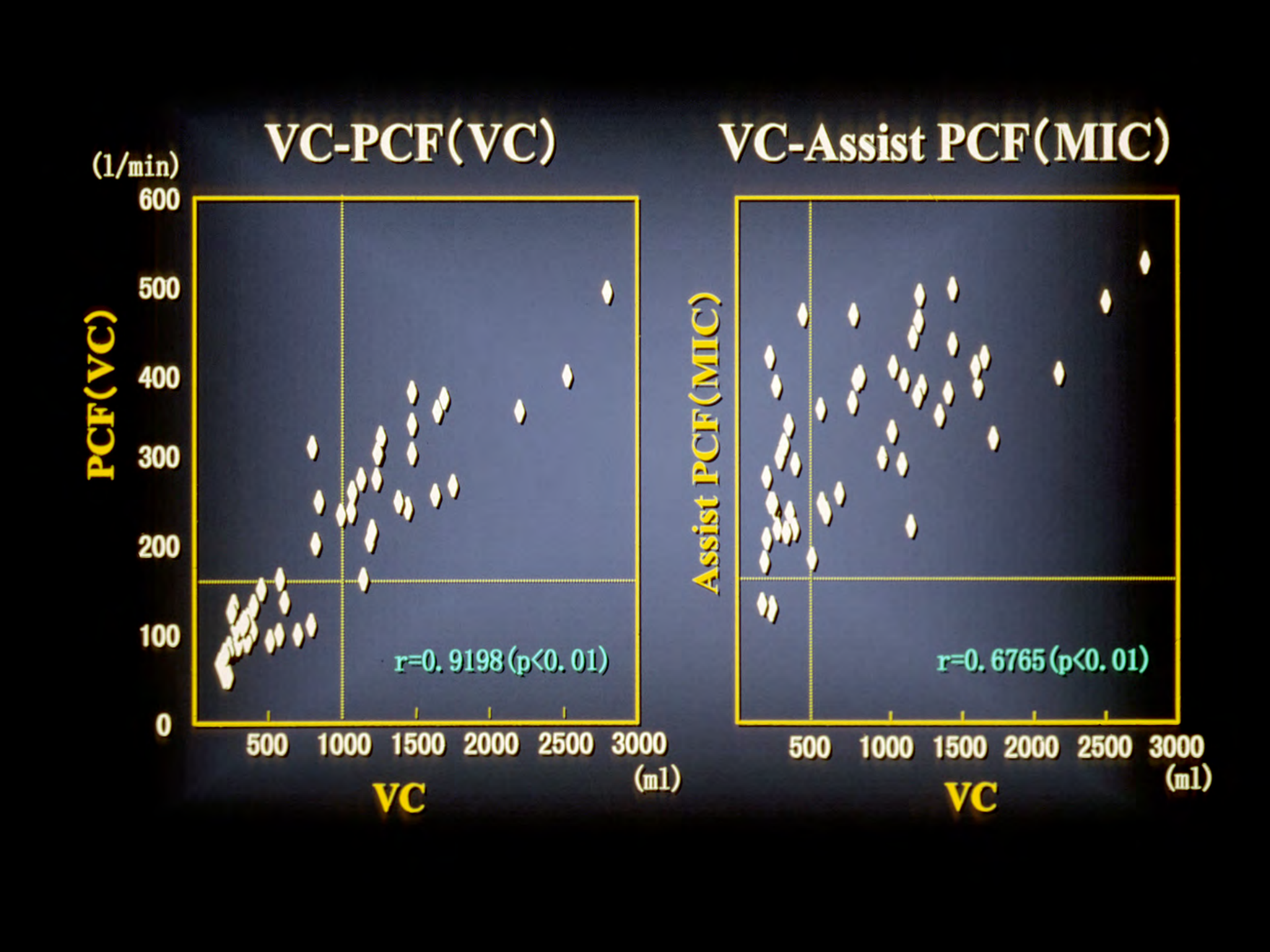

IRRITATION
INSPIRATION
COMPRESSION
EXPULSION



Fortunately for Sparky, Zeke knew the famous "Rex maneuver."



BRAVO!


VC-PCF(VC)
(l/min)
600
500
400
300
200
100
0
PCF(VC)
r=0.9198(p<0.01)
500 1000 1500 2000 2500 3000
(ml)
VC
VC-Assist PCF(MIC)
Assist PCF(MIC)
r=0.6765(p<0.01)
500 1000 1500 2000 2500 3000
(ml)
VC

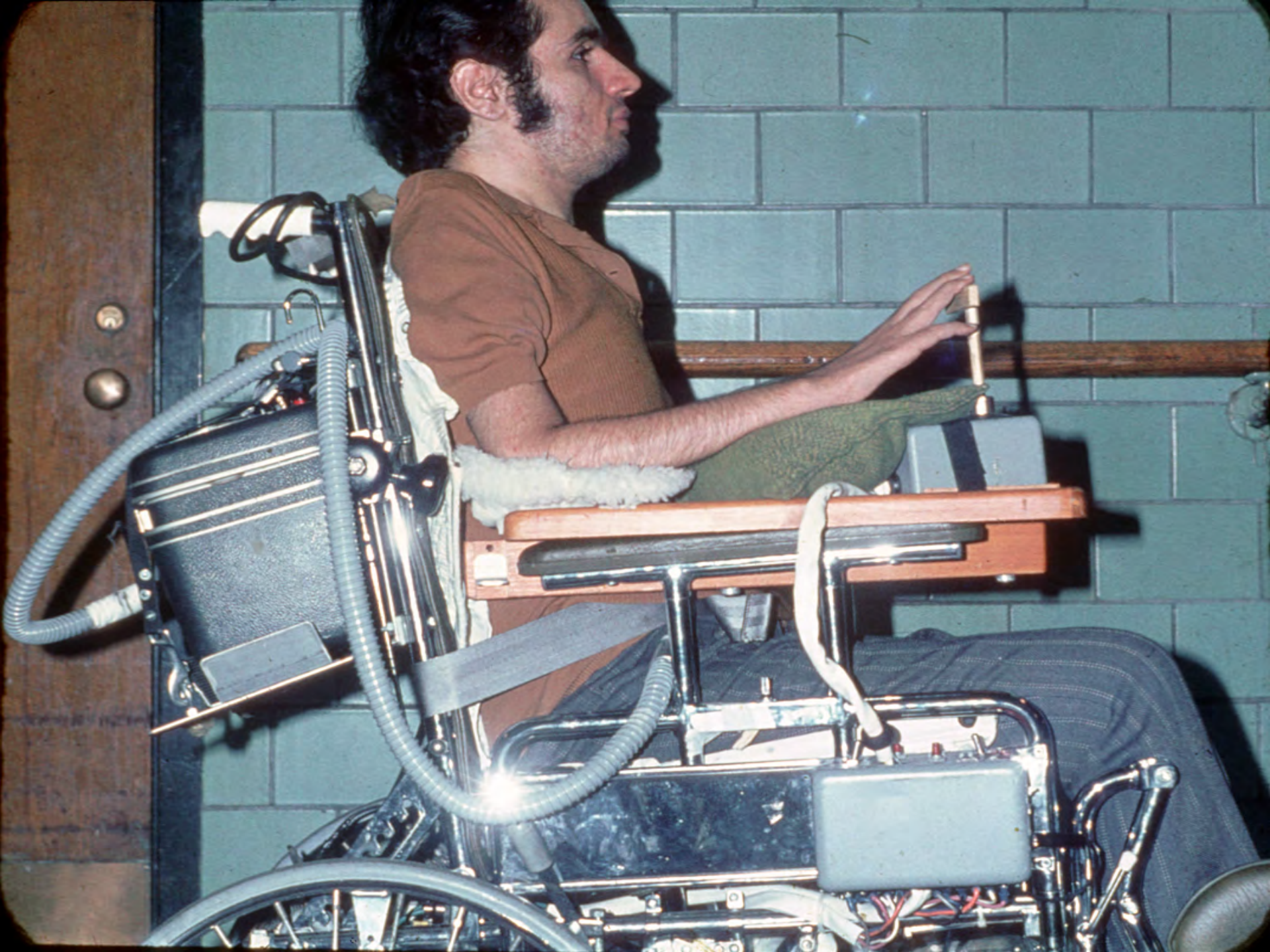
Maintain normal alveolar ventilation around the clock


ΔΔG
ΔΔG
PAF
PAF


أنى ؟!


FFF
P.S

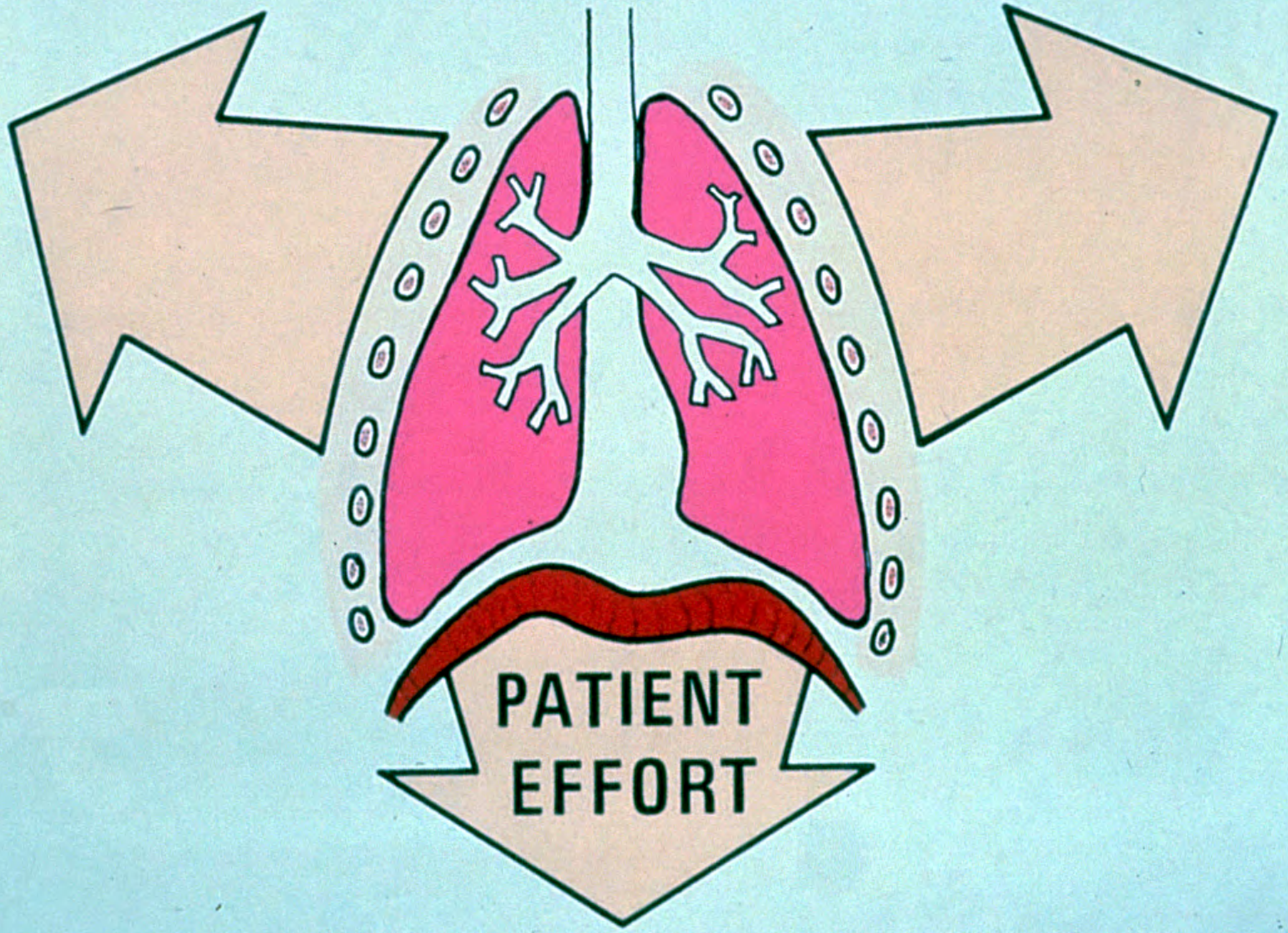

millennium
LE0104547
PLV-102b
LTVS#B01465
S#0160254
S#1772460
S#020118000832
S#331639
BiPAP S/T
S#1250
Achieva PS

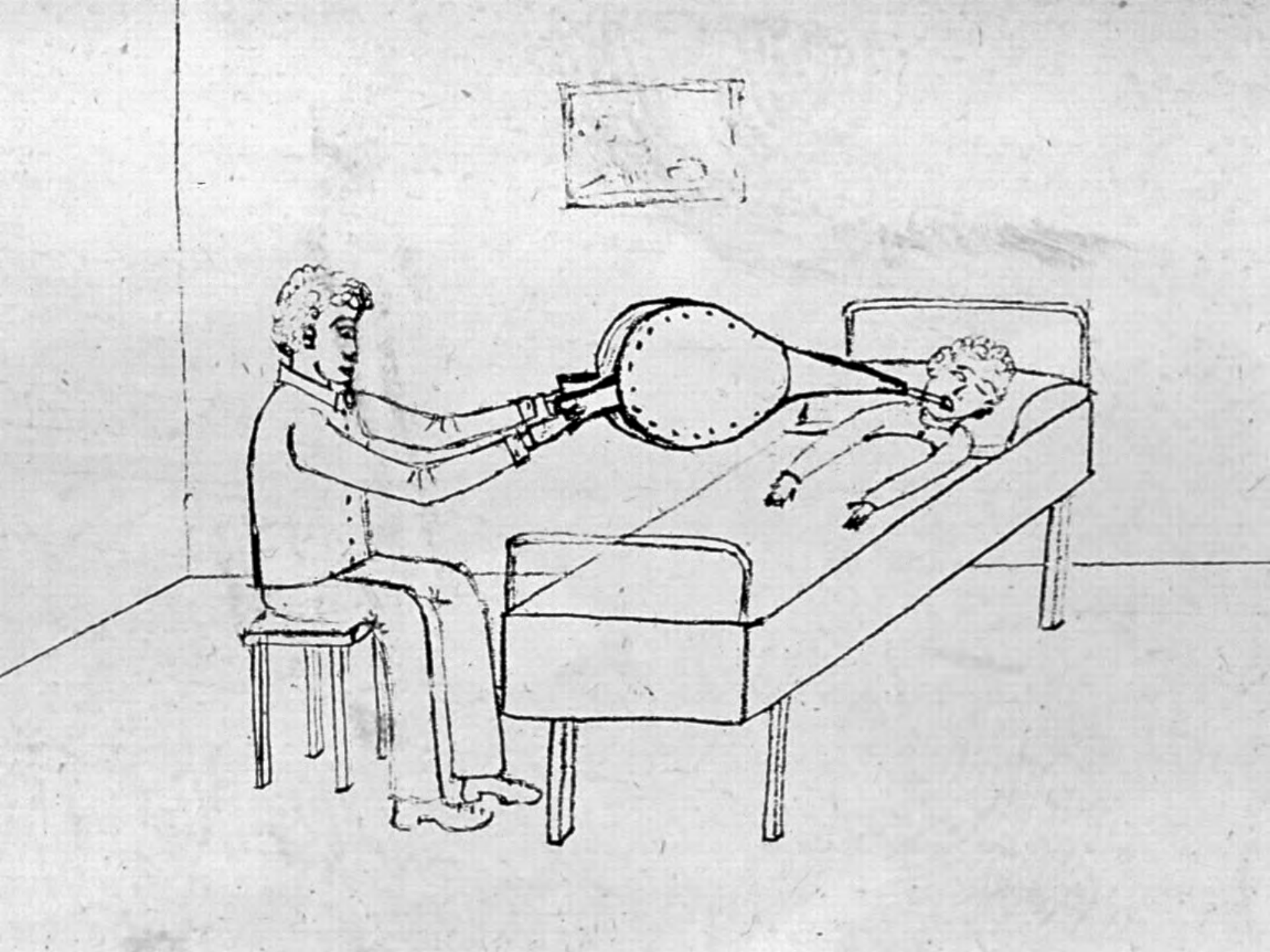



ALARMS
Low Pressure/Apnea
Low Power
High Pressure
Setting Error/Presilence
Power Switchover
Alarm Silence/Reset
POWER
AC Pwr/Batt Charge
External Battery
Internal Battery
Battery Test
PATIENT PRESSURE
cmH2O/hPa
Breathing Effort
Patient Pressure
Exhalation Valve
Clear
Pressure Limit Control
Patient Air
LP20
NELLCOR PURITAN BENNETT.

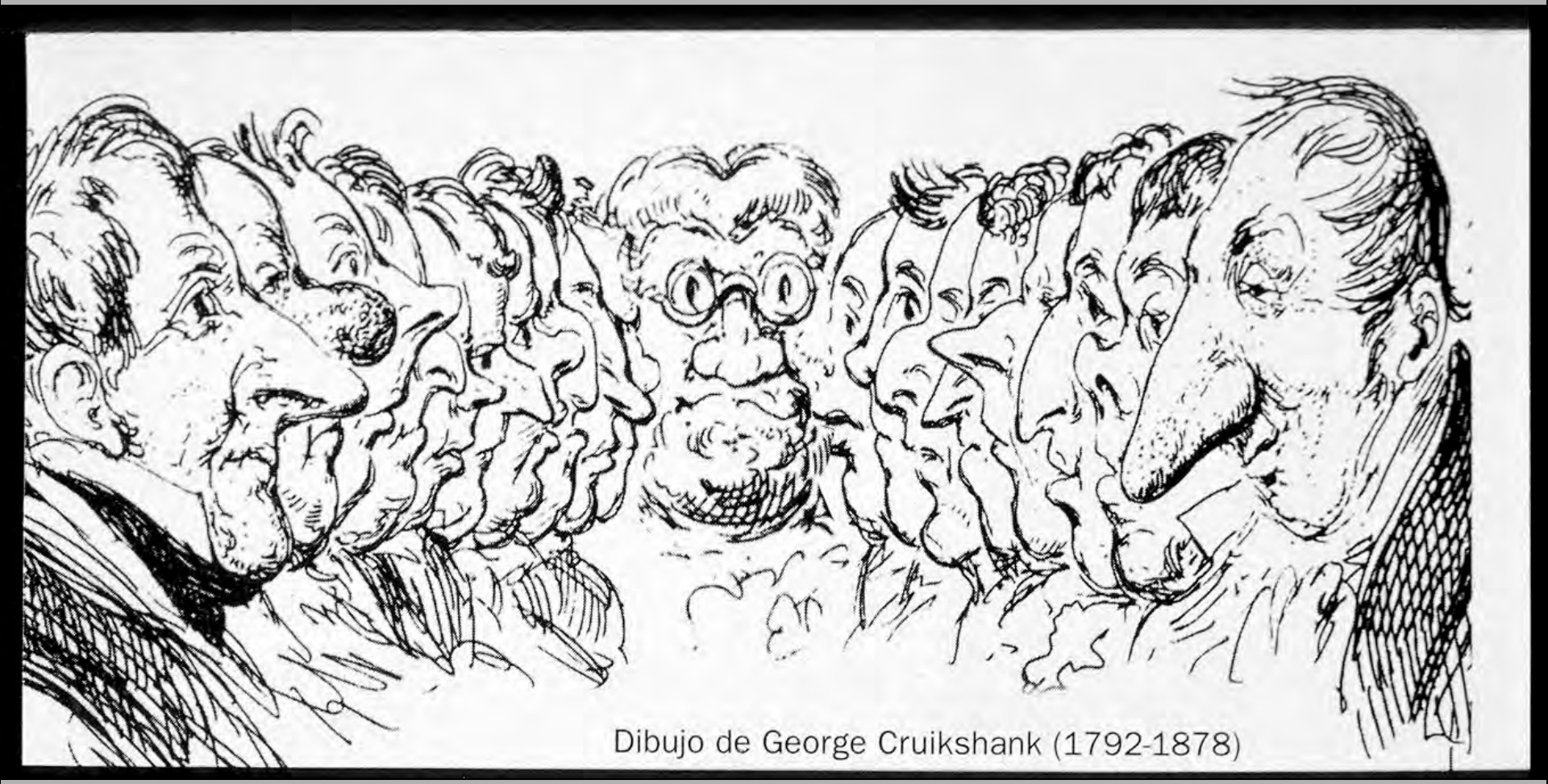
ALVEOLAR HYPOVENTILATION

COMPENSATED BY

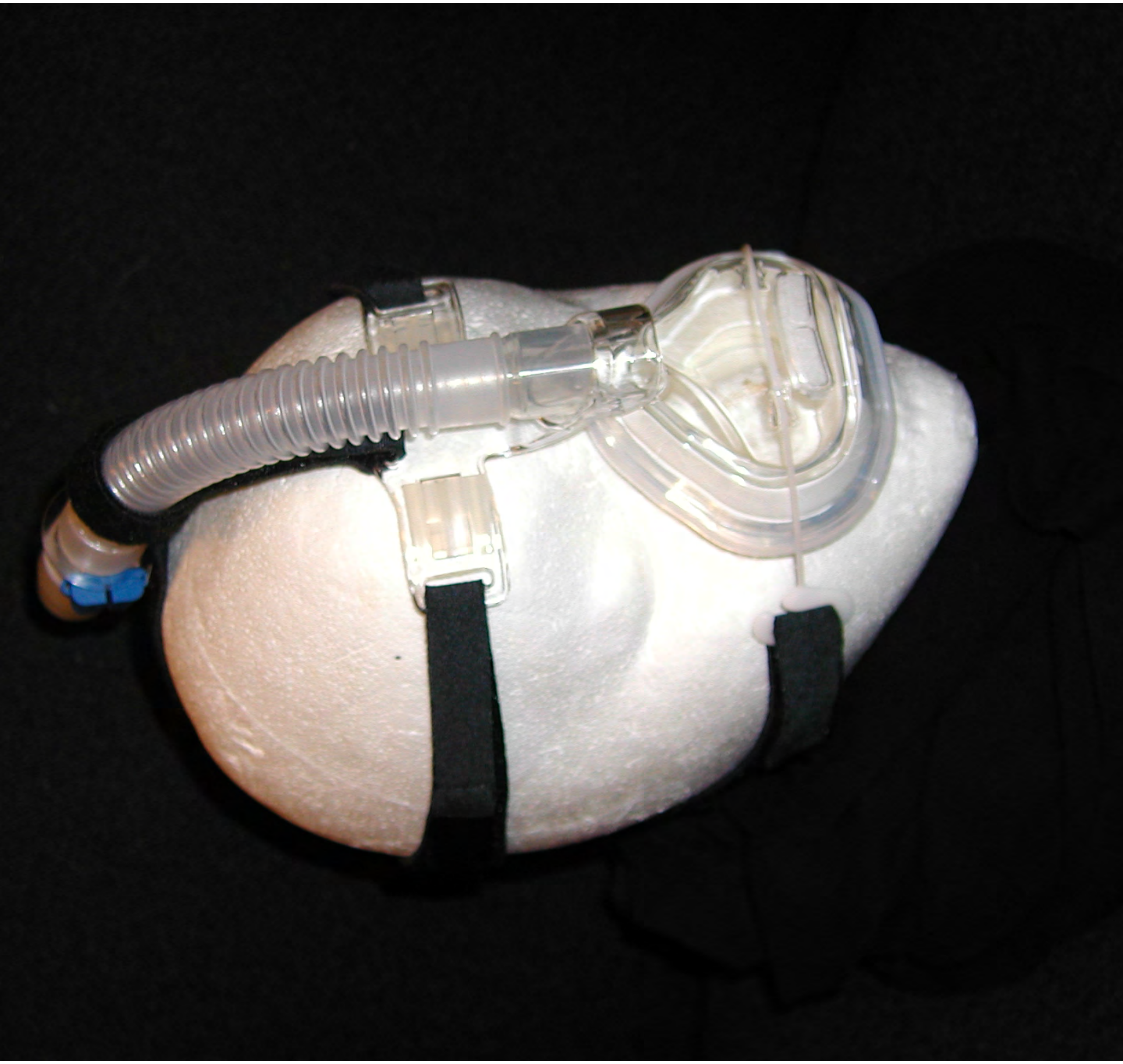




Pour Miguel de Colia
mars 2009 Sparta

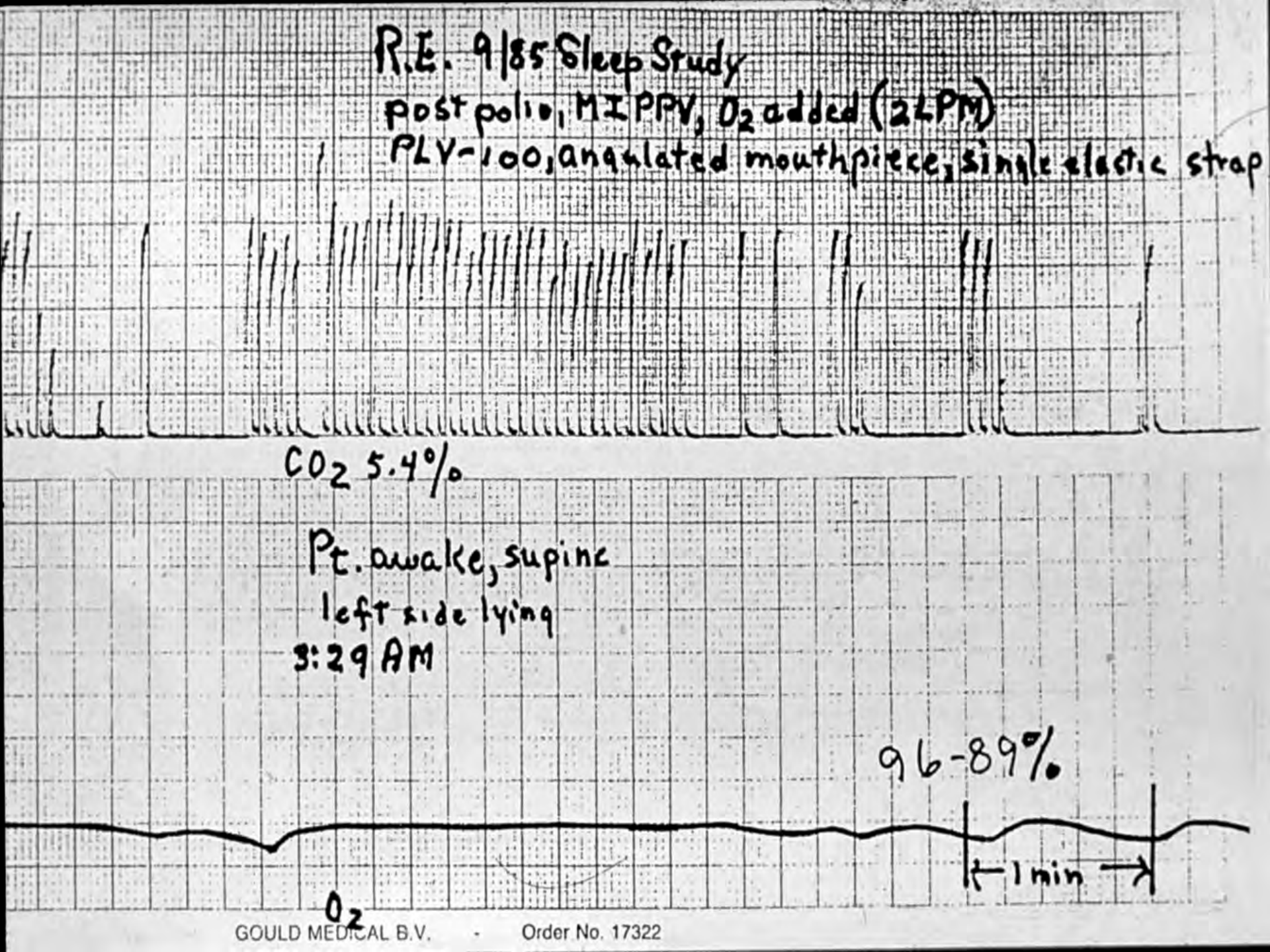


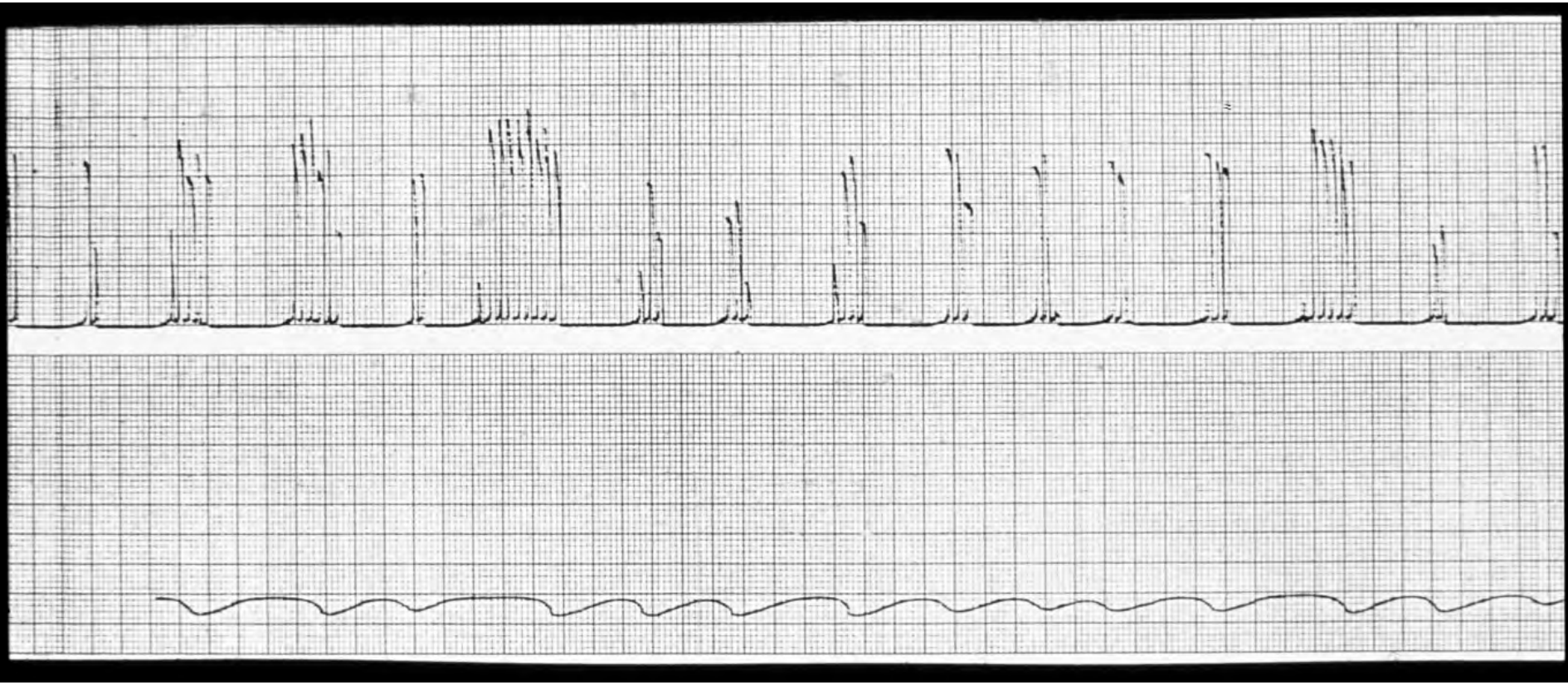
Dibujo de George Cruikshank (1792-1878)



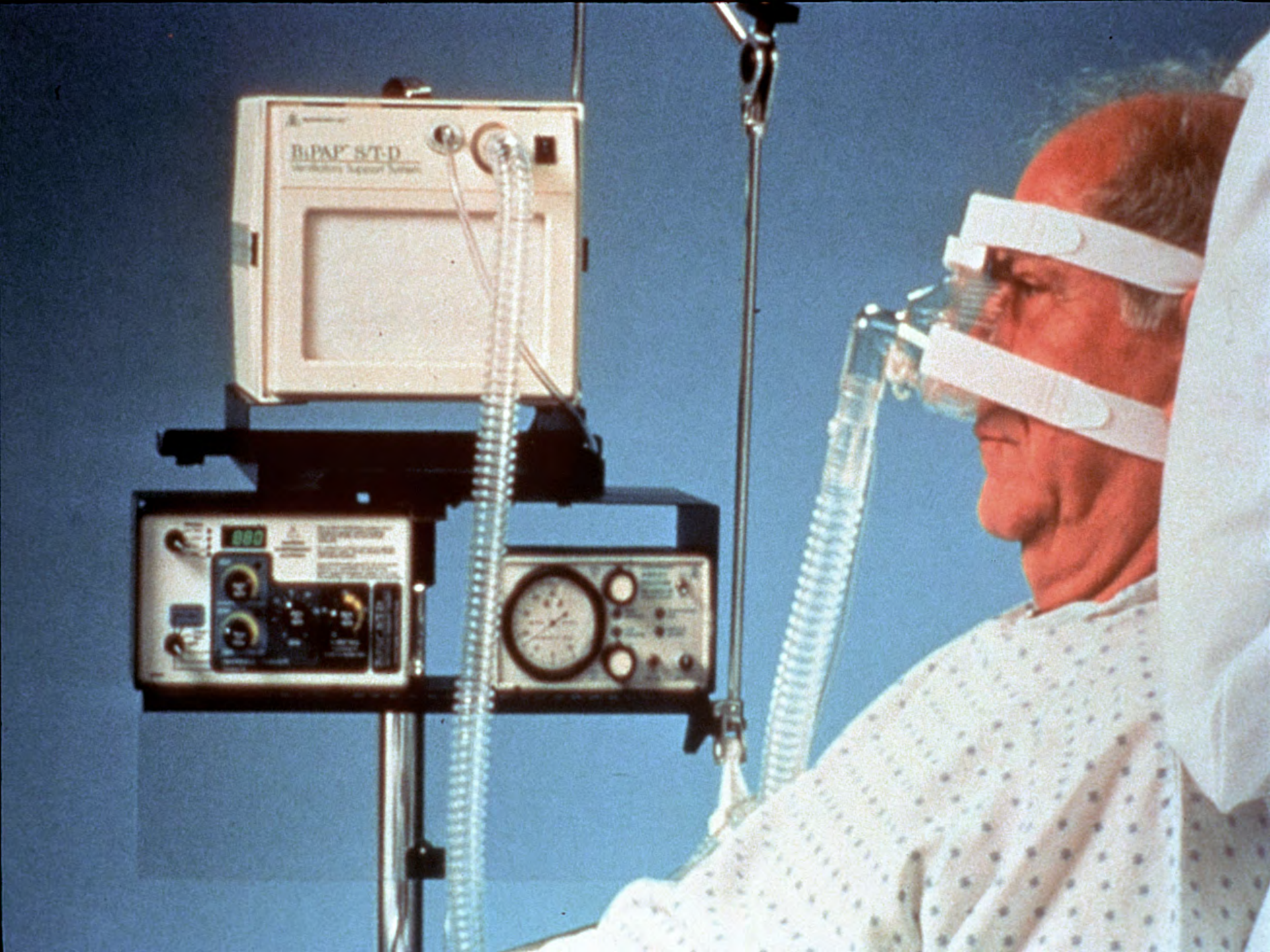
IDEAL INTERFACE

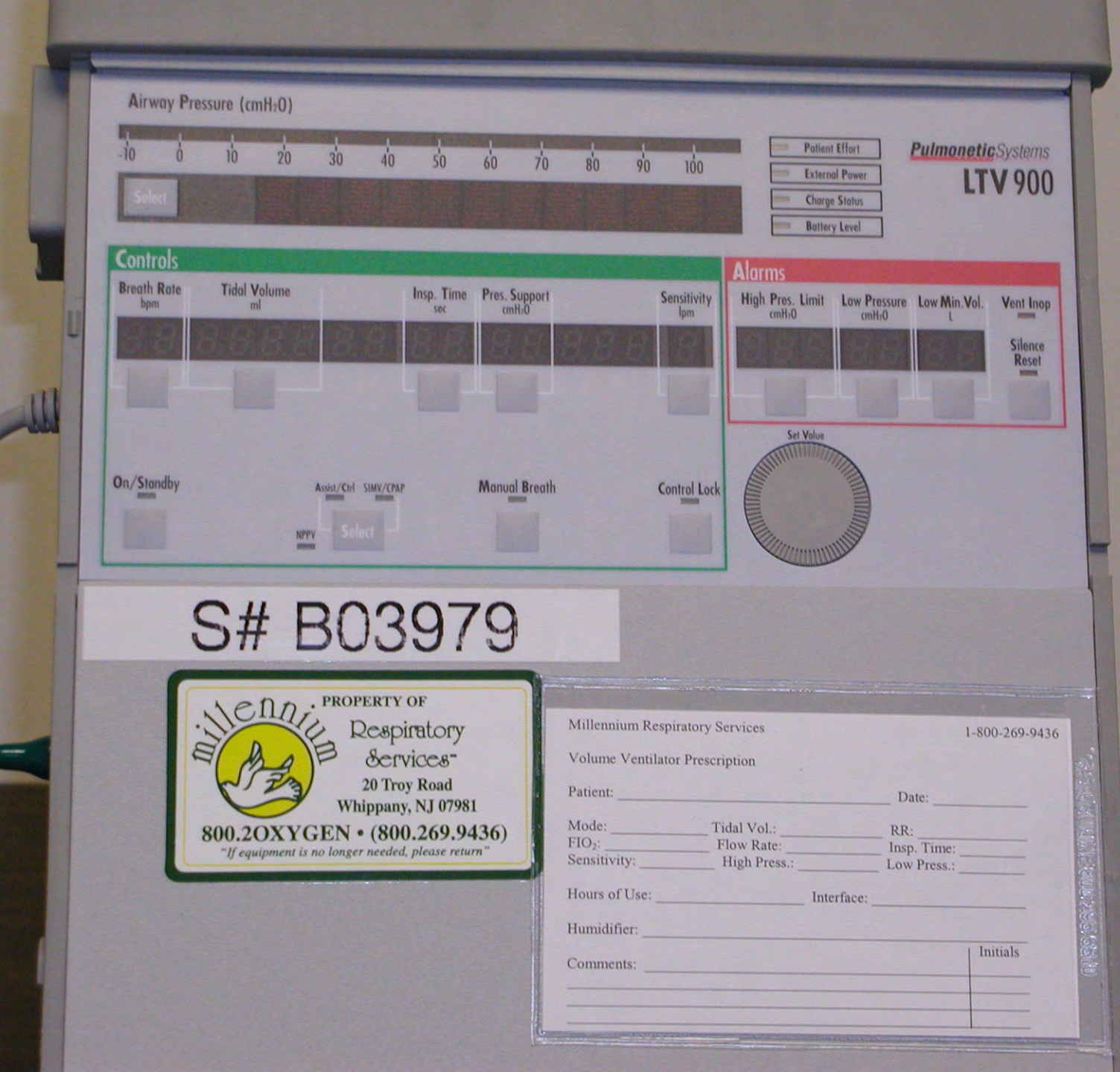
- LEAK FREE
- COMFORTABLE
- MAINTENANCE FREE






MOUTHPIECE
U.S. PAT.


BiPAP S/T-D


Airway Pressure (cmH2O)
-10 0 10 20 30 40 50 60 70 80 90 100
Select
Patient Effort
External Power
Charge Status
Battery Level
PulmoneticSystems
LTV 900
Controls
Breath Rate bpm
Tidal Volume ml
Insp. Time sec
Pres. Support cmH2O
Sensitivity lpm
On/Standby
Assist/Ctrl
SIMV/CPAP
NPPV
Select
Manual Breath
Control Lock
Alarms
High Pres. Limit cmH2O
Low Pressure cmH2O
Low Min. Vol. L
Vent Inop
Silence Reset
Set Value
S# B03979
PROPERTY OF
millennium
Respiratory Services
20 Troy Road
Whippany, NJ 07981
800.2OXYGEN • (800.269.9436)
"If equipment is no longer needed, please return"
Millennium Respiratory Services
1-800-269-9436
Volume Ventilator Prescription
Patient: Date:
Mode: Tidal Vol.: RR:
FIO2: Flow Rate: Insp. Time:
Sensitivity: High Press.: Low Press.:
Hours of Use: Interface:
Humidifier:
Comments: Initials


MODE
CONTROL
ASSIST CONTROL
SIMV
TIDAL VOLUME
.05 TO 3 LITERS
INCREASE
RATE:
PATIENT BPM
I:E RATIO
BLINKS DURING:
INVERSE I:E RATIO OR
READINGS OVER 1:9.9
(OFF DURING SIMV)
INSPIRATORY FLOW RATE
10 TO 120 LPM
INCREASE
INCREASE
INSPIRATORY FLOW
SENSITIVITY
ASSIST
SPONTANEOUS
cm H2O
LOW PRESSURE
ALARM SET
cm H2O
15 SECOND DELAY
PRESSURE
cmH2O
1 cmH2O
≈0.1 kPa
1cmH2O ≈ 1mbar ≈ 0.1kPa
EXHALATION
VALVE
ASSIST
PAP
PATIENT AIR
OUTLET
AIRWAY
PRESSURE LIMIT
cm H2O
PROPERTY OF
MILLENNIUM RESPIRATORY SERVICES
WHIPPANY, NJ 07981
800-269-9435
MHC-000758
LIFECARE®
PLV-100
12V
V
POWER
V
INTERNAL
EXTERNAL
BATTERY
READ BATTERY VOLTS
INTERNAL
VOLTS CAPACITY %
12-13 90
11-12 70
10-11 50
< 10 RECHARGE
EXTERNAL
ON
OFF
RECHARGE
30 SECOND
ALARM
SILENCE
EXTERNAL BATTERY
12V
DANGER: RISK OF EXPLOSION IF USED NEAR FLAMMABLE ANESTHETICS

Outpatient Protocol

- Maintain Spo2 > 94% at all times, especially during colds
- How? By using Mechanically assisted coughing (MAC) and noninvasive ventilation
- If Spo2 < 95%, you have either hypoventilation, mucus, or pneumonia

PROTOCOL – Dr. Bach

1. Oxygen administration limited only to approach 95% SpO_2.

2. Mechanical insufflation-exsufflation used via the tube at 25 to 40 cm H_2O to -25 to -40 cm H_2O pressures up to every 10 minutes as needed to reverse oxyhemoglobin desaturations due to airway mucus accumulation and when there is auscultatory evidence of secretion accumulation. Abdominal thrusts are applied during exsufflation. Tube and upper airway are suctioned following use of expiratory aids as needed.

3. Expiratory aids used when desaturations occur.

4. Ventilator weaning attempted without permitting hypercapnia.

5. Extubation attempted whether or not the patient is ventilator weaned when meeting the following:

A. Afebrile

B. No supplemental oxygen requirement to maintain SpO2 >94%

C. Chest radiograph abnormalities cleared or clearing

D. Any respiratory depressants discontinued

E. Airway suctioning required less than 1-2x/eight hours

F. Coryza diminished sufficiently so that suctioning of the nasal orifices is required less than once every 6 hours (important to facilitate use of nasal prongs/mask for post-extubation nasal ventilation)

6. Extubation to continuous nasal ventilation and no supplemental oxygen.

7. Oximetry feedback used to guide the use of expiratory aids, postural drainage, and chest physical therapy to reverse any desaturations due to airway mucus accumulation.

8. With CO_2 retention or ventilator synchronization difficulties nasal interface leaks were eliminated, pressure support and ventilator rate increased or the patient switched from BiPAP-ST™ to using a volume cycled ventilator. Persistent oxyhemoglobin desaturation despite eucapnia and aggressive use of expiratory aids indicated impending respiratory distress and need to re-intubate.

9. Following re-intubation the protocol was used for a second trial of extubation to nasal ventilation
...or following successful extubation bronchodilators and chest physical therapy were discontinued and the patient weaned to nocturnal nasal ventilation.

10. Discharge home after the SpO_2 remained within normal limits for 2 days and when assisted coughing was needed less than 4 times per day.


S#1791
MANUAL AUTO
cough assist
INHALE
EXHALE
PAUSE
INHALE PRESSURE
INHALE FLOW
PRESSURE
4500 Scout

Noninvasive ventilation can not be used when SpO2 is <94% with normocapnia

Bach JR, Baird JS, Plosky D, Nevado J, Weaver B. Spinal muscular atrophy type 1: management and outcomes. Pediatr Pulmonol 2002;34:16-22.

Bach JR. Amyotrophic lateral sclerosis: prolongation of life by noninvasive respiratory aids. Chest 2002;122:92-98.

Gomez-Merino E, Sancho J, Marin J, Servera E, Blasco ML, Bach JR, Baird JS, Plosky D, Nevado J, Weaver B. Spinal muscular atrophy type 1: management and outcomes. Pediatr Pulmonol 2002;34:16-22.

Bach JR (ed). Noninvasive Mechanical Ventilation. Philadelphia: Hanley & Belfus, 2002, 348 pages.

Indications for Tracheostomy

When the Spo2 decreases below 95%

and can not be normalized by NIV or MAC

Indications for Decanulation

Noninvasive ventilation can be used when assisted peak cough flows can exceed 160 L/m[1,2]

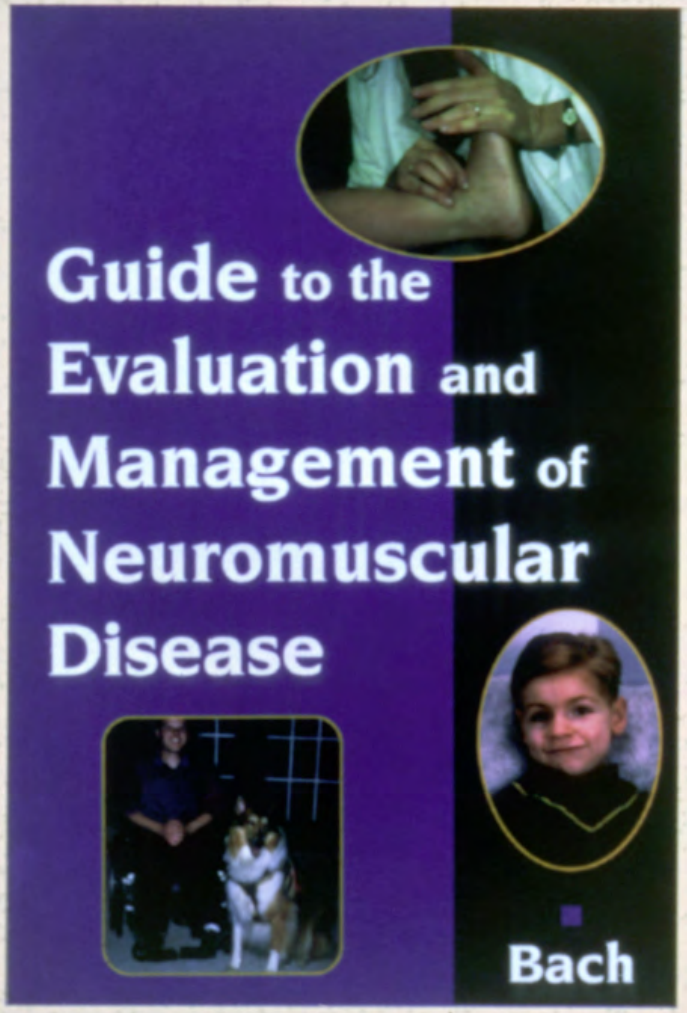
[1]Bach JR. Arch Phys Med Rehabil 1995;76:828-832.
[2]Bach JR, Saporito LR. Chest 1996;110:1566-1571.

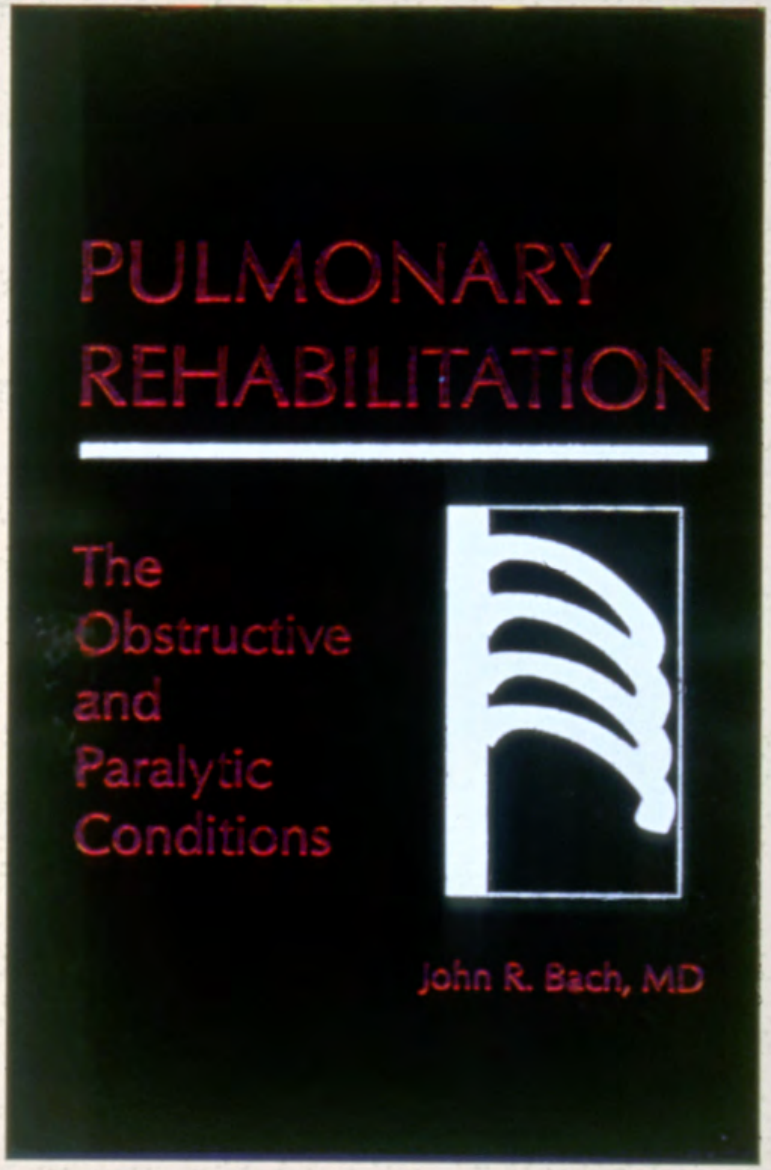
Noninvasive Mechanical Ventilation

John R. Bach, MD

Management of Patients with Neuromuscular Disease

John R. Bach, MD


Guide to the Evaluation and Management of Neuromuscular Disease
Bach


PULMONARY REHABILITATION
The Obstructive and Paralytic Conditions
John R. Bach, MD