SEMI

LA VISIÓN GLOBAL DE LA PERSONA ENFERMA

Grupo de formación SEMI

VENTILACIÓN MECÁNICA NO INVASIVA PARA INTERNISTAS

Escuela de Verano de Residentes de Medicina Interna

Dr Joaquín Alfonso Megido

Servicio de Medicina Interna

Hospital Valle del Nalón Asturias

19 - 22 de Junio 2013

OBJETIVOS

- CONOCER EL CONCEPTO, INDICACIONES,LOS MODOS Y LOS COMPONENTES DE LA VMNI
- ESTABLECER UN PROGRAMA DE INICIO
- MANEJAR LOS PRIMEROS AJUSTES
- IDENTIFICAR Y SOLUCIONR LOS PROBLEMAS MAS FRECUENTES
- CONOCER LOS CRITERIOS DE RETIRADA Y LA FORMA DE REALIZARLA

- Varón de **81 años**. Intolerancia gástrica a Levofloxacino. **Minero** de interior en la juventud. **Neumoconiosis de 3º grado** legal, complicada con masas de fibrosis masiva progresiva.
- **Exfumador** desde hace 30 años de 32 paquetes/año. Diagnosticado de **EPOC** 20 años antes (fenotipo agudizador tipo enfisema).
- ***Cor pulmonale* crónico** con episodios de insuficiencia cardiaca derecha.
- **Medicación habitual**: Oxigenoterapia crónica domiciliaria (OCD) por gafas nasales a 2 litros / minuto / 24 horas. Budesonida/Formoterol 320/9 mcg / 12 horas; Bromuro de Tiotropio 18 mcg / 24 horas; Salbutamol 100mcg 2 inh si disnea aguda; Teofilina 200 mg / 24 horas v.o.; Torasemida 10 mg.

- En los últimos días antes del ingreso presenta aumento de su disnea habitual, que en las últimas horas se ha vuelto más intensa hasta hacerse de reposo, con discreto aumento de la tos sin aumento en el volumen del esputo o cambios en la coloración del mismo, y acompañado de ortopnea y disnea paroxística nocturna. Negaba fiebre, dolor torácico o edemas, aunque sí presentaba somnolencia en los últimos días.
- Valorado en su domicilio por el médico de Atención Primaria, se pauta tratamiento con Hidrocortisona 100 mg intravenosos, Salbutamol y Bromuro de Ipratropio nebulizados por cámara de Hudson, y se administra oxigenoterapia por mascarilla con reservorio, siendo derivado al Servicio de Urgencias Hospitalarias.

- P.A. 138/82 mmHg; FC 88 l.p.m.; **FR 34 resp/min** con uso de **musculatura accesoria**; Tª 36.8ºC; Saturación de oxihemoglobina 100%.

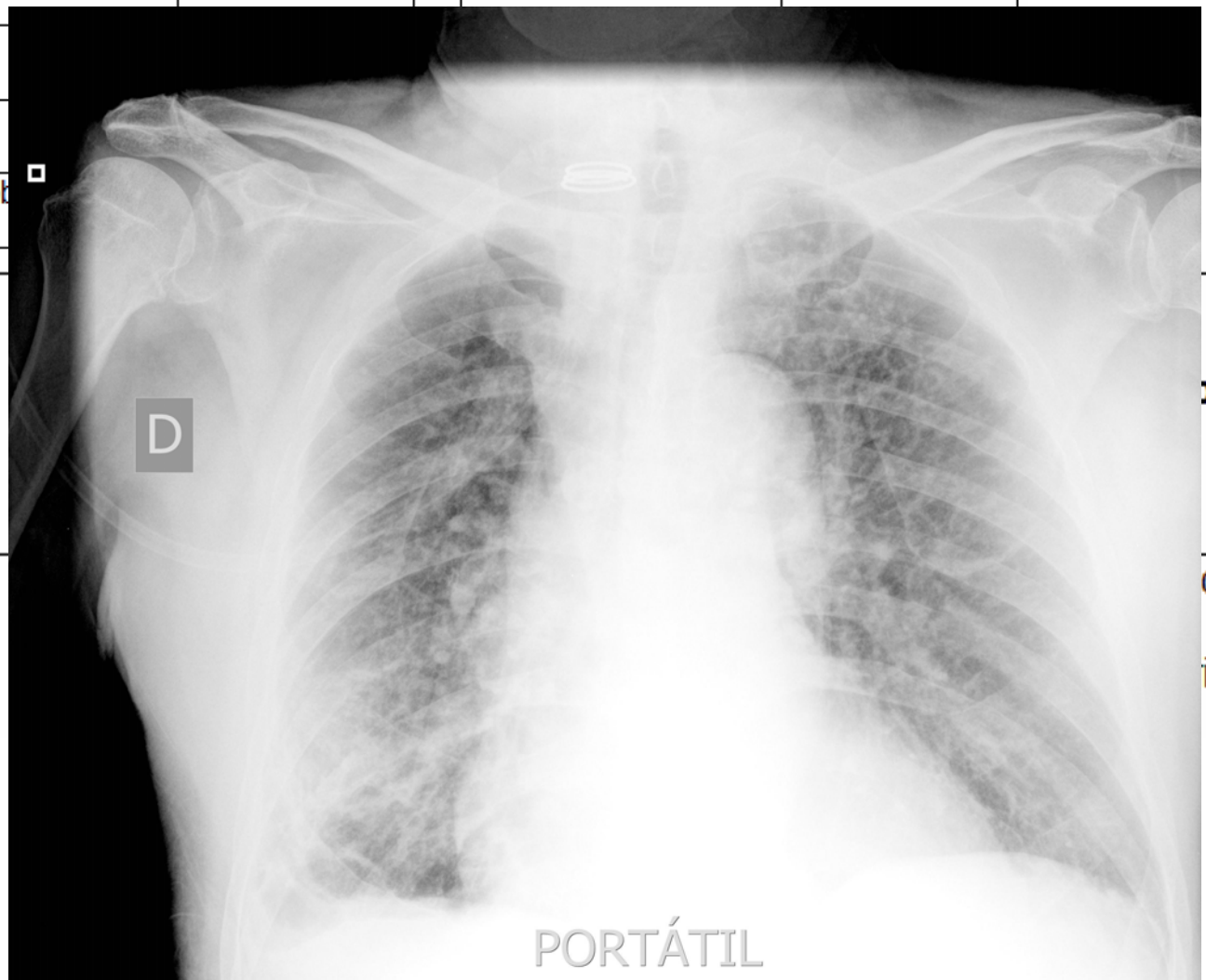
- Tendencia al sueño aunque reactivo a estímulos físicos. No ingurgitación yugular ni edemas.

- ACP: ruidos cardiacos rítmicos, sin presencia de soplos. Disminución de ruidos respiratorios normales y presencia de sibilancias diseminadas en ambos campos pulmonares.

- No signos de trombosis venosa profunda en las extremidades inferiores

Glucosa	174 mg/dL
Urea	35 mg/dL
Creatinina	1,03 mg/dL
Sodio	141 mmol/L
Potasio	
PCR	
Hemoglob	

VCM	88 fL
Hematocrito	39,2 %
Plaquetas	287.000/mm^3
Leucocitos	9.800/mm^3



Día de ingreso / Hora	**ones**
1º día 13:30 horas	carilla io

- Se inició tratamiento en el servicio de urgencias asociando:
  - antibióticos
  - tratamiento broncodilatador
  - esteroides
  - VMNI con BiPAP

- PREGUNTAS:
  - ¿Cuales son las INDICACIÓNES de la VMNI?
  - ¿Que MODO utilizaremos?
  - ¿Qué PARÁMETROS DE INICIO Y AJUSTES?

- VMNI: CONCEPTO
  - Soporte ventilatorio
  - Sin intubación de vía aérea
- OBJETIVOS
  - Disminuir el trabajo respiratorio
    - Mejora disnea
  - Aumenta la ventilación alveolar
    - Mejora pH
    - Aumenta oxigenación

INDICACIONES VMNI EN INSUFICIENCIA RESPIRATORIA AGUDA

- Nivel A:
  - **Reagudización EPOC**
  - EAP
  - Fallo respiratorio agudo en inmunodeprimidos
  - Destete EPOC

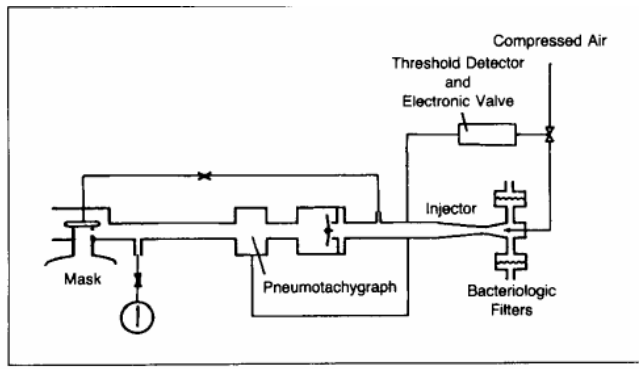


Figure 1. Schematic Representation of the Circuit Used to Delive Inspiratory Assistance.

The pneumotachygraph is used to trigger the start of inspirator assistance. The electronic valve controls the pressurization of the circuit with a jet of compressed air.

REVERSAL OF ACUTE EXACERBATIONS OF CHRONIC OBSTRUCTIVE LUNG DISEASE BY INSPIRATORY ASSISTANCE WITH A FACE MASK

LAURENT BROCHARD, DANIEL ISABEY, JACQUES PIQUET, PIEDADE AMARO, JORGE MANCEBO, AMEN-ALLAH MESSADI, CHRISTIAN BRUN-BUISSON, ALAIN RAUSS, FRANÇOIS LEMAIRE, AND ALAIN HARF

Abstract *Background.* Patients with acute exacerbations of chronic obstructive pulmonary disease may require endotracheal intubation with mechanical ventilation. We designed, and here report on the efficacy of, a noninvasive ventilatory-assistance apparatus to provide inspiratory-pressure support by means of a face mask.

Methods. We assessed the short-term (45-minute) physiologic effects of the apparatus in 11 patients with acute exacerbations of chronic obstructive pulmonary disease and evaluated its therapeutic efficacy in 13 such patients (including 3 of the 11 in the physiologic study) who were treated for several days and compared with 13 matched historical-control patients.

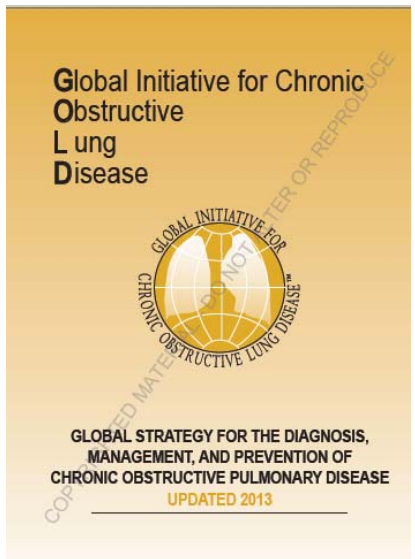
Results. In the physiologic study, after 45 minutes of inspiratory positive airway pressure by face mask, the mean (±SD) arterial pH rose from 7.31±0.08 to 7.38±0.07 (P<0.01), the partial pressure of carbon dioxide fell from 68±17 mm Hg to 55±15 mm Hg (P<0.01), and the partial pressure of oxygen rose from 52±12 mm Hg to 69±16 mm Hg (P<0.05). These changes were accompanied by marked reductions in respiratory rate (from 31±7 to 21±9 breaths per minute, P<0.01).

Only 1 of the 13 patients treated with inspiratory positive airway pressure needed tracheal intubation and mechanical ventilation, as compared with 11 of the 13 historical controls (P<0.001). Two patients in each group died. As compared with the controls, the treated patients had a more transient need for ventilatory assistance (3±1 vs. 12±11 days, P<0.01) and a shorter stay in the intensive care unit (7±3 vs. 19±13 days, P<0.01).

Conclusions. Inspiratory positive airway pressure delivered by a face mask can obviate the need for conventional mechanical ventilation in patients with acute exacerbations of chronic obstructive pulmonary disease. (N Engl J Med 1990; 323:1523-30.)

INDICACIONES VMNI EN INSUFICIENCIA RESPIRATORIA AGUDA

- Nivel A:
  - **Reagudización EPOC**



Noninvasive mechanical ventilation. The use of noninvasive mechanical ventilation (NIV) has increased significantly over time among patients hospitalized for acute exacerbations of COPD. NIV has been studied in randomized controlled trials showing a success rate of 80-85% [443-446,543]. NIV has been shown to improve acute respiratory acidosis (increases pH and decreases $PaCO_2$), decrease respiratory rate, work of breathing, severity of breathlessness, complications such as ventilator associated pneumonia, and length of hospital stay (**Evidence A**). More importantly, mortality and intubation rates are reduced by this intervention[444,447-449] (**Evidence A**).

Table 5.5. Therapeutic Components of Hospital Management

RESPIRATORY SUPPORT
Oxygen therapy
Ventilatory support
Noninvasive ventilation
Invasive ventilation
PHARMACOLOGIC TREATMENT
Bronchodilators
Corticosteroids
Antibiotics
Adjunct therapies

Outcomes of Noninvasive Ventilation for Acute Exacerbations of Chronic Obstructive Pulmonary Disease in the United States, 1998–2008

Divay Chandra[1]*, Jason A. Stamm[1]*, Brian Taylor[2], Rose Mary Ramos[1], Lewis Satterwhite[2], Jerry A. Krishnan[3], David Mannino[4], Frank C. Sciurba[1], and Fernando Holguin[1]

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Noninvasive Ventilation for Acute Respiratory Failure

RESPIRATORY CARE • JUNE 2013 VOL 58 NO 6

Dean R Hess PhD RRT FAARC

Andres Carrillo, Miquel Ferrer, Gumersindo Gonzalez-Diaz, Antonia Lopez-Martinez, Noemi Llamas, Maravillas Alcazar, Lucia Capilla, and Antoni Torres "Noninvasive Ventilation in Acute Hypercapnic Respiratory Failure Caused by Obesity Hypoventilation Syndrome and Chronic Obstructive Pulmonary Disease", American Journal of Respiratory and Critical Care Medicine, Vol. 186, No. 12 (2012), pp. 1279-1285.
doi: 10.1164/rccm.201206-1101OC

Noninvasive Ventilation in Acute Hypercapnic Respiratory Failure Caused by Obesity Hypoventilation Syndrome and Chronic Obstructive Pulmonary Disease

Andres Carrillo[1], **Miquel Ferrer**[2,3], **Gumersindo Gonzalez-Diaz**[1], **Antonia Lopez-Martinez**[1], **Noemi Llamas**[1], **Maravillas Alcazar**[1], **Lucia Capilla**[1], and **Antoni Torres**[2,3]

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

INDICACIONE
RESPIAR

- Nivel B:
  - **Neumonía EPOC**
  - Fracaso extubacio
    EPOC
  - Fallo respiratorio
    hipoxémico
  - **No intubables**
  - **Fallo respiratorio**
    en post operatori

Effect of noninvasive mechanical ventilation in elderly patients with hypercapnic acute-on-chronic respiratory failure and a do-not-intubate order

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Pierfranco Usai[1]
Monica Bernareggi[1]
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Mona-Rita Yacoub[4]
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Abstract: Noninvasive mechanical ventilation (NIMV) is effective in the treatment of patients with acute respiratory failure (ARF). It proved to reduce the need of endotracheal intubation (ETI), the incidence of ETI-associated pneumonia, and mortality compared to non ventilated patients. A particular aspect concerns the outcome of NIMV inpatients referring to an emergency room (ER) for ARF, and with a do-not- intubate (DNI) status due to advanced age or critical conditions. The aim of our study is to assess the outcome of NIMV in a group of elderly patients with acute hypercapnic ARF who had a DNI status. An overall number of 62 subjects (30 males, 32 females, mean age 81 ± 4.8 years, range 79–91 years) referred to our semi-intensive respiratory department were enrolled in the study. The underlying diseases were severe chronic obstructive pulmonary disease (COPD) in 50/62 subjects, restrictive thoracic disorders in 7/62 subjects, and multiorgan failure in 5/62 subjects. Fifty- four/62 patients were successfully treated with NIMV while 2/62 did not respond to NIMV and were therefore submitted to ETI (one survived). Among NIMV-treated patients, death occurred in 6 patients after a mean of 9.9 days; the overall rate of NIMV failure was 12.9%. Negative prognostic factors for NIMV response proved to be: an older age, a low Glasgow Coma Score, a high APACHE score at admission, a high $PaCO_2$ after 12 hours and a low pH both after 1 and 12 hours of NIMV. We conclude that elderly patients with acute hypercapnic ARF with a DNI status can be successfully treated by NIMV.

Keywords: acute respiratory failure, noninvasive mechanical ventilation, endotracheal intubation, do-not-intubate, COPD, oxygen therapy

Introduction

Noninvasive mechanical ventilation (NIMV) is effective in the treatment of patients with acute respiratory failure (ARF), as shown by controlled trials and meta-analysis (Bott et al 1993; Kramer et al 1995; Plant et al 2000; Brochard et al 2002; Lightowler et al 2003). In particular, NIMV proved to reduce the need of endotracheal intubation (ETI) (Antonelli et al 1998), to prevent ETI-associated pneumonia (Nourdine et al 1999; Carlucci et al 2001) and to decrease incidence of mortality compared to nonventilated patients (Keenan et al 2004). During last decades NIMV use is continuously increasing (Carlucci et al 2001; Demoule et al 2006), despite consensus documents established the rationale, and therefore also some limitations, to resort to NIMV in severe chronic obstructive lung disease (COPD), restrictive thoracic disorders, and nocturnal hypoventilation (ACCP 1999). Nevertheless, NIMV may have some negative effects, for example the delay in using ETI when the respiratory conditions require such measure, an unsatisfactory outcome in patients with ARF due to severe community acquired pneumonia, and the risk to develop an aspiration pneumonia in patients with altered level of consciousness (Jolliet et al 2001; Metha and Hill 2001; Esteban et al 2004).

INDICACIONES EN INSUFICIENCIA RESPIRATORIA AGUDA

- Nivel C:
  - SDRA
  - Neumonía en no EPOC
  - Fibrosis quística
  - SAOS
  - Traumatismo torácico
  - Destete en no EPOC

Surviving Sepsis Campaign: International Guidelines for Management of Severe Sepsis and Septic Shock: 2012

R. Phillip Dellinger, MD[1]; Mitchell M. Levy, MD[2]; Andrew Rhodes, MB BS[3]; Djillali Annane, MD[4]; Herwig Gerlach, MD, PhD[5]; Steven M. Opal, MD[6]; Jonathan E. Sevransky, MD[7]; Charles L. Sprung, MD[8]; Ivor S. Douglas, MD[9]; Roman Jaeschke, MD[10]; Tiffany M. Osborn, MD, MPH[11]; Mark E. Nunnally, MD[12]; Sean R. Townsend, MD[13]; Konrad Reinhart, MD[14]; Ruth M. Kleinpell, PhD, RN-CS[15]; Derek C. Angus, MD, MPH[16]; Clifford S. Deutschman, MD, MS[17]; Flavia R. Machado, MD, PhD[18]; Gordon D. Rubenfeld, MD[19]; Steven A. Webb, MB BS, PhD[20]; Richard J. Beale, MB BS[21]; Jean-Louis Vincent, MD, PhD[22]; Rui Moreno, MD, PhD[23]; and the Surviving Sepsis Campaign Guidelines Committee including the Pediatric Subgroup*

8. That noninvasive mask ventilation (NIV) be used in that minority of sepsis-induced ARDS patients in whom the benefits of NIV have been carefully considered and are thought to outweigh the risks (grade 2B).

CONTRAINDICACIONES VMNI

Figure 5.4-9. Indications for Invasive Mechanical Ventilation

- Unable to tolerate NIV or NIV failure (for exclusion criteria, see **Figure 5.4-8**)
- Severe dyspnea with use of accessory muscles and paradoxical abdominal motion.
- Respiratory frequency > 35 breaths per minute
- Life-threatening hypoxemia
- Severe acidosis (pH < 7.25) and/or hypercapnia ($PaCO_2$ > 8.0 kPa, 60 mm Hg)
- Respiratory arrest
- Somnolence, impaired mental status
- Cardiovascular complications (hypotension, shock)
- Other complications (metabolic abnormalities, sepsis, pneumonia, pulmonary embolism, barotrauma, massive pleural effusion)

Eur Respir J 2005; 25: 348–355
DOI: 10.1183/09031936.05.00085304

A chart of failure risk for noninvasive ventilation in patients with COPD exacerbation

M. Confalonieri*, G. Garuti[#], M.S. Cattaruzza[¶], J.F. Osborn[¶], M. Antonelli[+], G. Conti[+], M. Kodric*, O. Resta[§], S. Marchese[ƒ], C. Gregoretti and A. Rossi, on behalf of the Italian noninvasive positive pressure ventilation (NPPV) study group[##]**

		pH admission <7.25		pH admission 7.25–7.29		pH admission >7.30	
	RR	APACHE ≥29	APACHE <29	APACHE ≥29	APACHE <29	APACHE ≥29	APACHE <29
GCS 15	<30	29	11	18	6	17	6
	30–34	42	18	29	11	27	10
	≥35	52	24	37	15	35	14
GCS 12–14	<30	48	22	33	13	32	12
	30–34	63	34	48	22	46	21
	≥35	71	42	57	29	55	27
GCS ≤11	<30	64	35	49	23	47	21
	30–34	76	49	64	35	62	33
	≥35	82	59	72	44	70	42

FIGURE 2. Failure risk chart of noninvasive positive pressure ventilation at admission (the values in the table correspond to the percentage of patients who fail in each category). 0–24%; 25–49%; 50–74%; 75–100%. RR: respiratory rate; APACHE: acute physiology and chronic health evaluation II score; GCS: Glasgow Coma

		pH after 2 h <7.25		pH after 2 h 7.25–7.29		pH after 2 h ≥7.30	
	RR	APACHE ≥29	APACHE <29	APACHE ≥29	APACHE <29	APACHE ≥29	APACHE <29
GCS 15	<30	72	35	27	7	11	3
	30–34	88	59	49	17	25	7
	≥35	93	73	64	27	38	11
GCS 12–14	<30	84	51	41	13	19	5
	30–34	93	74	65	28	39	12
	≥35	96	84	78	42	54	20
GCS ≤11	<30	93	74	65	28	39	12
	30–34	97	88	83	51	63	26
	≥35	99	93	90	66	76	40

FIGURE 3. Failure risk chart of noninvasive positive pressure ventilation after 2 h (the values in the table correspond to the percentage of patients who fail in each category). 0–24%; 25–49%; 50–74%; 75–100%. RR: respiratory rate; APACHE: acute physiology and chronic health evaluation II score; GCS: Glasgow Coma Scale.

Conclusions

The efficacy of noninvasive positive pressure ventilation in acute exacerbation of chronic obstructive pulmonary disease is so well documented that international guidelines [28] recommend it as the first choice treatment of acute respiratory failure with respiratory acidosis. Nevertheless, given that noninvasive positive pressure ventilation is used in a variety of care settings, it may be important to know the likelihood of failure to decide upon the best choice between noninvasive positive pressure ventilation and endotracheal intubation instituted earlier. The prediction charts are based on data collected by the present authors and take into consideration all relevant clinical prognostic indicators and are derived from a population representing the patients seen routinely in clinical practice. Thus, the current authors think they could greatly help the decision on clinical management of the patient. Using the chart, it is possible to predict *"a priori"* the probability of noninvasive positive pressure ventilation failure and reduce the useless and prolonged use of noninvasive positive pressure ventilation in patients with respiratory acidosis due to chronic obstructive pulmonary disease exacerbation.

First Huddle, at initiation of NIV

	Yes	No
Is NIV being used in lieu of intubation?	☐	☐
Does the patient have hypoxemic respiratory failure? (not related to cardiogenic edema or immunocompromise)	☐	☐
Will the patient be intubated if NIV fails?	☐	☐
Are relative contraindications for NIV present? (altered mental status, airway protection, aspiration risk, copious secretions)	☐	☐
Is patient tolerating NIV poorly/appearing uncomfortable?	☐	☐
Is much coaching required for patient to tolerate NIV?	☐	☐
Will frequent titration of settings be required?	☐	☐
Is patient hemodynamically unstable?	☐	☐
Does patient remain hypoxemic? (SpO_2 < 92% or FIO_2 > 0.6)	☐	☐

A "yes" response to any of the above should prompt consideration of transfer to ICU.

What is the goal for NIV in this patient?

How will we decide if NIV is failing?

What is the alternative if NIV fails?

Has pulmonary medicine been consulted? _____ yes _____ no

Second Huddle, after 2 hours of NIV

	Yes	No
Has gas exchange and dyspnea improved in past 2 hours?	☐	☐
Is the goal of NIV being met?	☐	☐
Does patient tolerate removal of the mask for at least 30 minutes?	☐	☐
Is patient tolerating NIV and comfortable?	☐	☐
Is SpO_2 > 92% and FIO_2 < 0.6?	☐	☐
Is patient hemodynamically stable?	☐	☐
Does patient tolerate NIV without excessive coaching?	☐	☐
Is patient stable on IPAP ≤ 15 cm H_2O?	☐	☐

A "no" response to any of the above should prompt consideration of transfer to the ICU.

Will patient be moved to ICU? _____ yes _____ no

If no, has pulmonary medicine been consulted? _____ yes _____ no

Has the medical attending been notified? _____ yes _____ no

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SERIES "NONINVASIVE VENTILATION IN ACUTE AND CHRONIC RESPIRATORY FAILURE"
Edited by M.W. Elliott and N. Ambrosino
Number 3 in this Series

Where to perform noninvasive ventilation?

M.W. Elliott*, M. Confalonieri#, S. Nava¶

Where to perform noninvasive ventilation? M.W. Elliott, M. Confalonieri, S. Nava. ©*ERS Journals Ltd 2002.*
ABSTRACT: Noninvasive positive-pressure ventilation (NPPV) has been shown to be a means of reducing the need for endotracheal intubation, which when effective reduces

*St James's University Hospital, Leeds, UK, #Dept of Pneumology, Hospital of Trieste, Trieste and ¶Respiratory Unit, Fondazione S.Maugeri, Pavia, Italy.

Conclusion

Staff training and experience is more important than location, and adequate numbers of staff skilled in noninvasive positive-pressure ventilation must be available throughout the 24-h period. Because of the demands of looking after these acutely-ill patients, and to aid training and skill retention, noninvasive positive-pressure ventilation is usually best carried out in one single sex location with one nurse responsible for no more than three to four patients in total. Basic monitoring should be available. Whether this is called an intensive care unit, a high dependency unit or is part of a general ward is largely irrelevant. Available data suggests that noninvasive positive-pressure ventilation for acute and chronic respiratory failure is a cost- effective intervention.

DÓNDE VENTILAR

- ÁREA DE URGENCIAS
- UNIDAD DE MEDICINA INTENSIVA
- SALA DE REANIMACIÓN QUIRÚRGICA
- UNIDAD DE CUIDADOS INTERMEDIOS
- SALA DE HOSPITALIZACIÓN CONVENCIONAL
- DOMICILIO

Table 3. – Training requirements

Understanding rationale for assisted ventilation
Mask and headgear fitting techniques
Ventilator circuit assembly
Theory of operation and adjusting ventilation to achieve desired outcome
Cleaning and general maintenance
Problem solving - the ability to recognise serious situations and act accordingly
Above all medical, nursing and technical staff need to be convinced that the technique works
Specific educational programs may help acceptance of NPPV among personnel


¿CÓMO VENTILAR?

COMPONENTES DE LA VMNI

RESPIRADOR

INTERFASE

PACIENTE

TIPOS DE VMNI

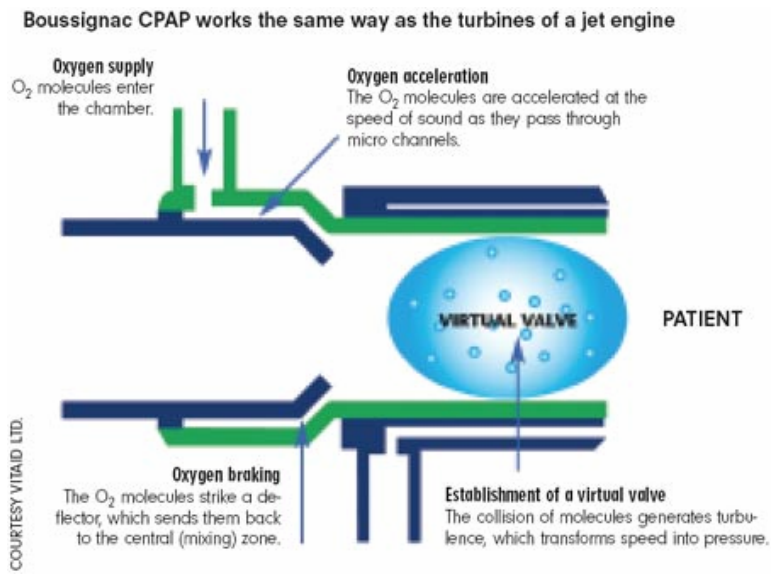
- VOLUMEN
  - CONTROLADA Y ASISTO-CONTROLADA
- PRESIÓN
  - **BiPAP (dos niveles de presion)**
  - **CPAP**
  - VPA

CPAP

- No es en si misma una ventilación mecánica
- Se fija un nivel de presión constante durante todo el ciclo respiratorio
- No aumenta la ventilación
- Aumenta oxigenación
- Indicada fundamentalmente en EAP cardiogénico

- VENTILADOR EN MODO PRESION

- SISTEMAS VALVULARES:
- BOUSSIGNAC
  - FLUJO TURBULENTO CAPAZ DE GENERAR UNA PRESION MEDIBLE
  - FLUJO GENERADO CON AIRE O CON OXÍGENO




VYCON
Stationskoffer


CS-U
VACIO
MEDICINAL

MODOS DE VMNI: BiPAP

- Dos niveles de presión
  - iPAP
  - ePAP

  P de soporte = diferencia
- Normalmente en espontánea

BiPAP: otros parámetros a programar

- Trigger inspiratorio (sensibilidad de disparo de inicio por cambio de flujo/presion)
- Trigger espiratorio (momento de apertura espiratoria por caída de flujo inspiratorio)
- Rampa o pendiente de flujo
- Alarmas
- Oxígeno

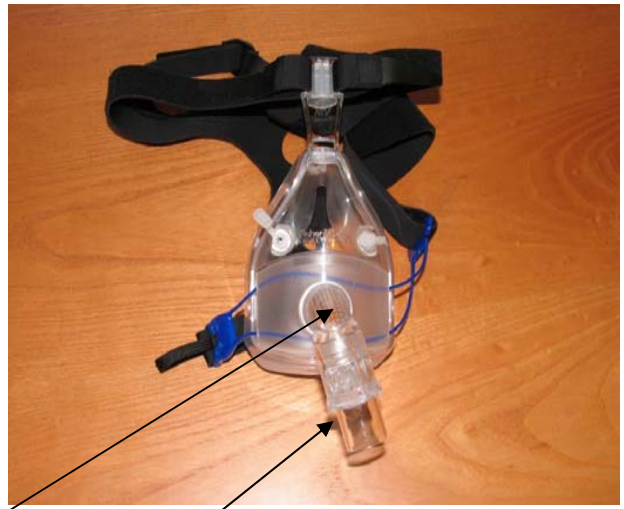
INTERFASE

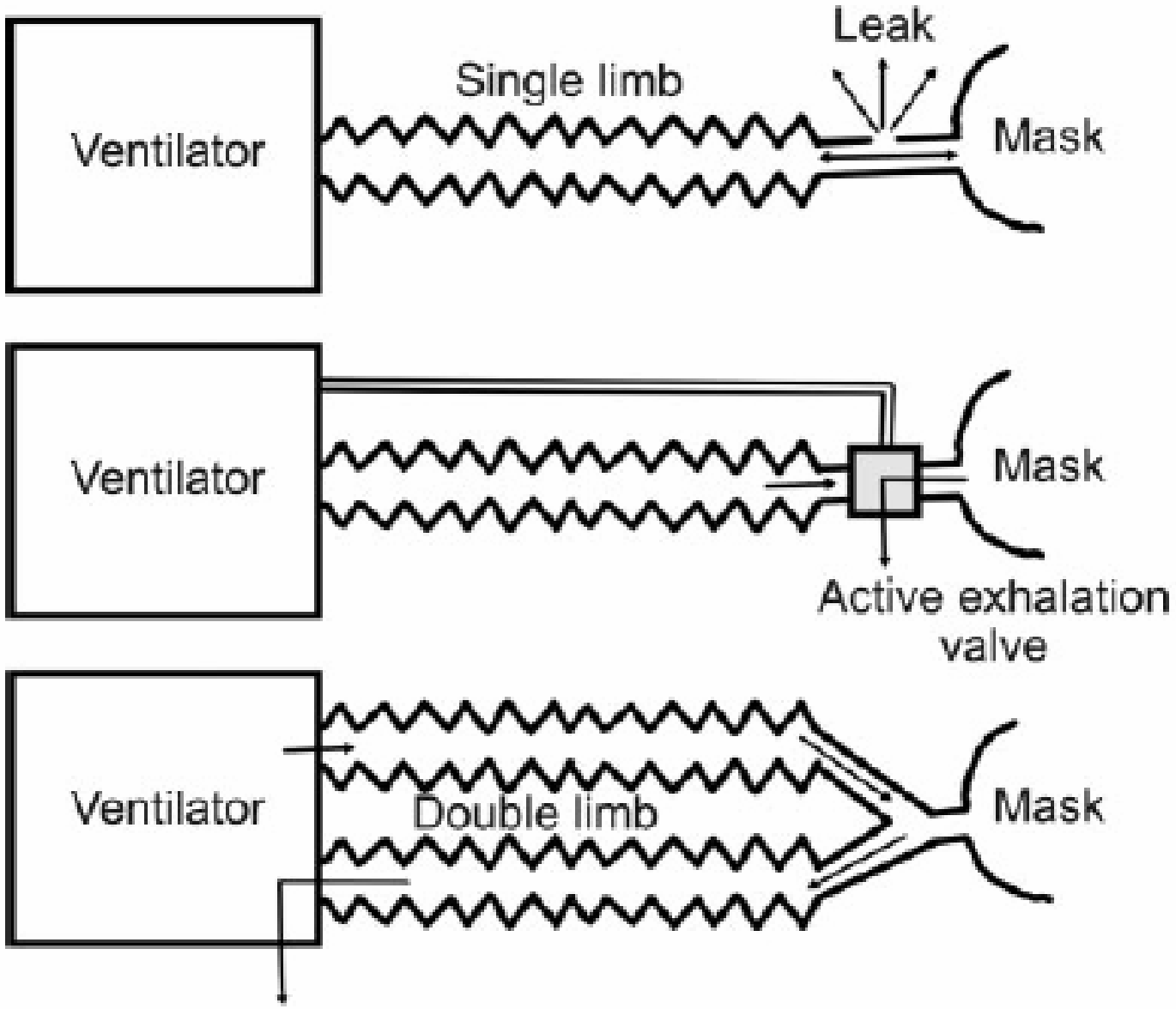
- MASCARILLA
  - NASAL
  - ORONASAL
  - FACIAL COMPLETA
  - HELMET
- ARNES
- TUBULADURA

ESPIRACIÓN

- A través de la **válvula espiratoria** situada en la mascarilla o tubuladura

- Diferente de válvula antiasfixia




Ventilator
Single limb
Leak
Mask
Ventilator
Mask
Active exhalation valve
Ventilator
Double limb
Mask

CRITERIOS DE INICIO

- CLÍNICOS
  - Disnea
  - FR>25-30
  - Musculatura accesoria
- Gasométricos
  - pH<7,35 PaCO2>45
  - PaO2/FiO2<200

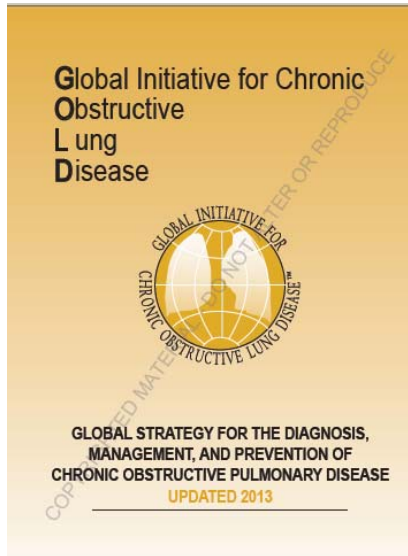


Table 5.7. Indications for Noninvasive Mechanical Ventilation[281,445,461,462]

At least one of the following:

- Respiratory acidosis (arterial pH ≤ 7.35 and/or $PaCO_2$ ≥ 6.0 kPa, 45 mm Hg)
- Severe dyspnea with clinical signs suggestive of respiratory muscle fatigue, increased work of breathing, or both, such as use of respiratory accessory muscles, paradoxical motion of the abdomen, or retraction of the intercostal spaces

INICIO DE LA VMNI

Pasos previos:

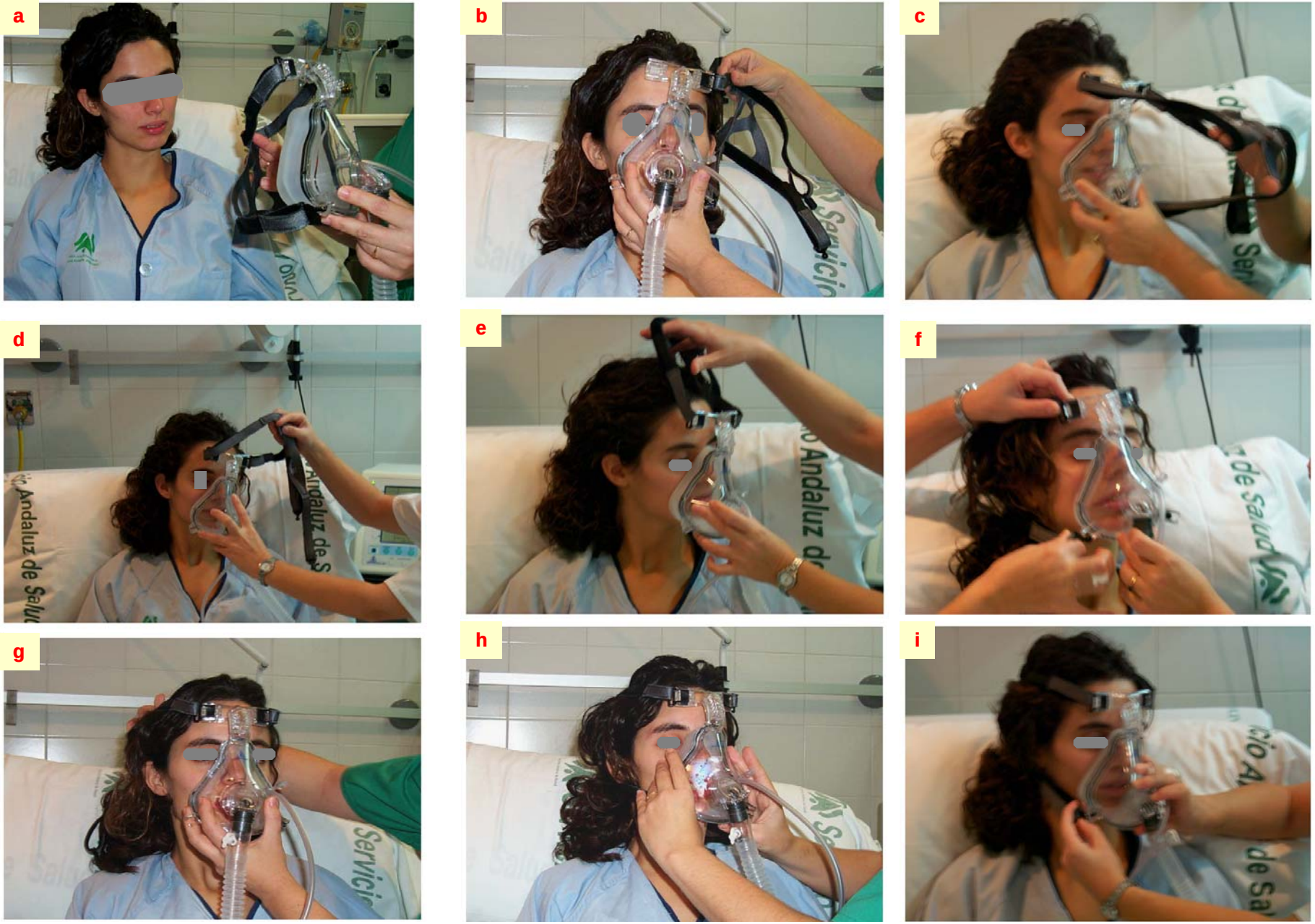
- Informar y explicar al paciente (y familia) en que consiste la técnica, tranquilizarlo, darle confianza
- Colocar al enfermo en posición semisentado,
- Controlar la tensión arterial, la frecuencia respiratoria, la frecuencia cardiaca y la SpO2 por pulsioximetría.
- Escoger la máscara facial adecuada y conectarla al aparato.
- Encender el ventilador, silenciar las alarmas y establecer el programa básico de inicio.

PROGRAMA DE INICIO

- BIPAP:
  - en espontánea
  - empezar con una IPAP de 8-10 cmH2O
  - EPAP de 4-5 cmH2O
    - 4-8 respiraciones mandatorias
    - Trigger inspiratorio 2
    - Trigger espiratorio 2
    - Rampa presion 1-2
  - flujo de O2 a 4-8 L/min o el necesario para una SpO2 alrededor 90%.
- CPAP: comenzar con 5 cmH2O.

INICIO

- Aplicar suavemente la máscara (siempre con el respirador funcionando) sobre la cara, hasta que el paciente se encuentre cómodo y sincronizado con el ventilador. En individuos muy angustiados se puede dejar que él mismo se aplique la mascarilla hasta que pierda el temor.
- Proteger el puente nasal con un apósito coloide para evitar las erosiones o las úlceras por presión o decúbito.
- Fijar la máscara con el arnés para mínima fuga posible (Entre la máscara y la cara debe pasar un dedo).



Secuencia de pasos para la colocación correcta de la máscara facial (oronasal) de Ventilación Mecánica No Invasiva. Paso 1 (a): Presentación de la máscara. Paso 2 (b,c,d,e): Aplicación de la máscara. Paso 3 (f, g): Fijación del arnés. Paso 4 (h): Comprobación de fugas. Paso 5 (i): Ajuste final de la máscara.

Caso VMNI: evolución

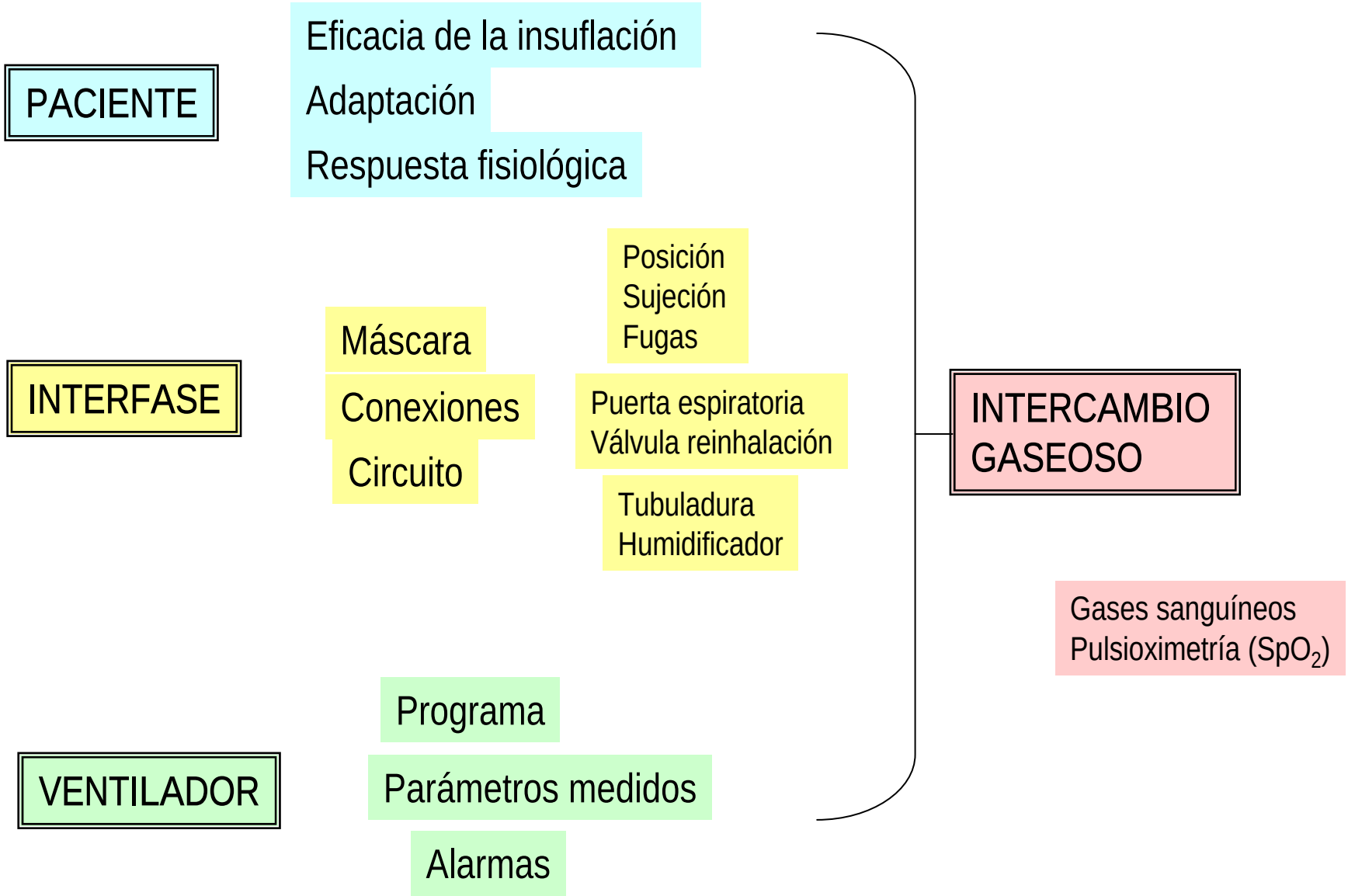
- Inicialmente se partió de IPAP de 8 cmH2O y 4 de EPAP
- Incre
- los
PaC
l/min
- El pa

Día de ingreso / Hora	pH	pCO_2	pO_2	HCO_3	Saturación de oxiHg (%)	Observaciones
1º día 13:30 horas	7,19	84,6	163	30,9	98,2	Con mascarilla con reservorio
1º día 15:30 horas	7,30	66,4	59	31,7	90,4	Control tras 2 h con VMNI.

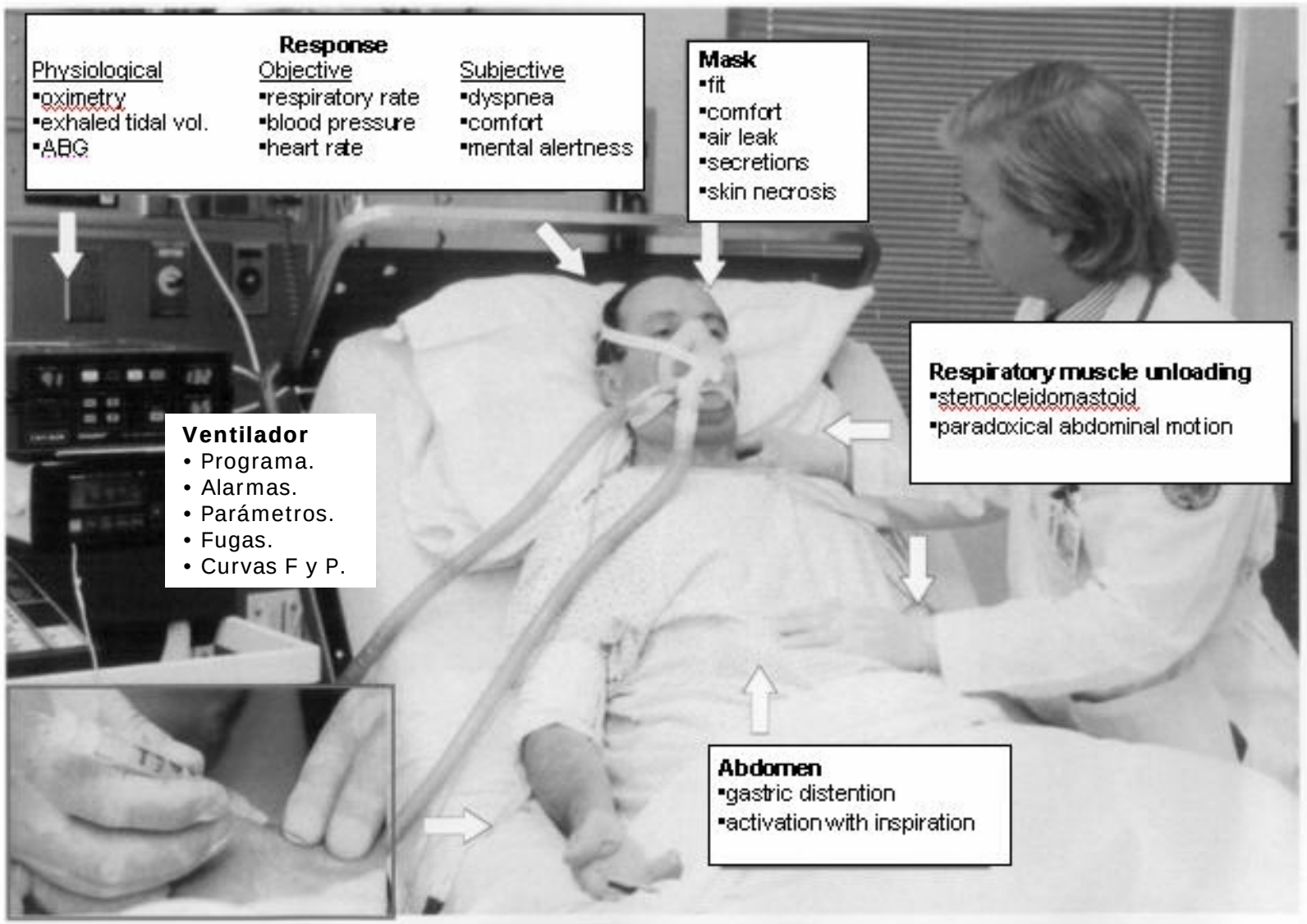
59,
10

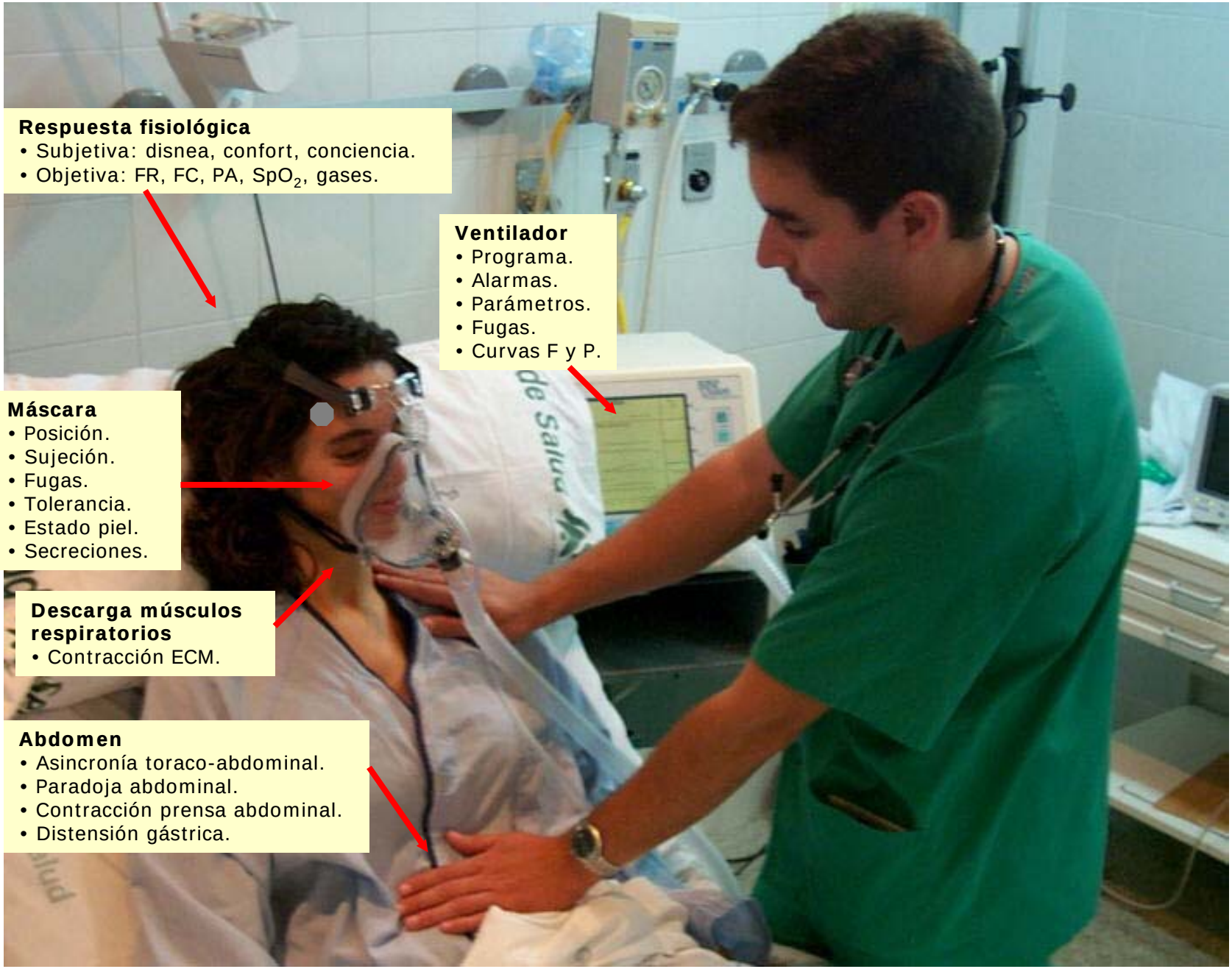
PREGUNTAS

- monitorización
- Mantenimiento y ajustes de la VMNI



La vigilancia de la ventilación mecánica no invasiva se centra en el paciente, la interfase y el ventilador. La resultante final debe ser un intercambio gaseoso adecuado.


Response
Physiological
▪oximetry
▪exhaled tidal vol.
▪ABG
Objective
▪respiratory rate
▪blood pressure
▪heart rate
Subjective
▪dyspnea
▪comfort
▪mental alertness
Mask
▪fit
▪comfort
▪air leak
▪secretions
▪skin necrosis
Respiratory muscle unloading
▪sternocleidomastoid
▪paradoxical abdominal motion
Ventilador
• Programa.
• Alarmas.
• Parámetros.
• Fugas.
• Curvas F y P.
Abdomen
▪gastric distention
▪activation with inspiration


Respuesta fisiológica
• Subjetiva: disnea, confort, conciencia.
• Objetiva: FR, FC, PA, SpO_2, gases.
Ventilador
• Programa.
• Alarmas.
• Parámetros.
• Fugas.
• Curvas F y P.
Máscara
• Posición.
• Sujeción.
• Fugas.
• Tolerancia.
• Estado piel.
• Secreciones.
Descarga músculos respiratorios
• Contracción ECM.
Abdomen
• Asincronía toraco-abdominal.
• Paradoja abdominal.
• Contracción prensa abdominal.
• Distensión gástrica.

AJUSTES INMEDIATOS

- Subir IPAP de 2 en 2 cm H2O cada 15-20 minutos hasta obtener
  - volumen corriente aprox 7 mL/kg (auscultación)
  - frecuencia respiratoria < 25 rpm
  - menor disnea
  - no uso de los músculos accesorios (contracción del esternocleidomastoideo, abdomen)
  - confortabilidad.

AJUSTES INMEDIATOS

- Regular la EPAP de 2 en 2 cmH2O para que no haya inspiraciones fallidas, lo cual indicaría que la PEEP intrínseca (PEEPi) o auto-PEEP está compensada.
- Oxígeno según necesidad para saturar alrededor 90%
- Activar las alarmas del monitor y del ventilador.

AJUSTES INMEDIATOS

- Preguntar frecuentemente al enfermo por sus necesidades (posición de la máscara, dolor, incomodidad, fugas molestas, deseo de expectorar) o posibles complicaciones (más disnea, distensión abdominal, nauseas, vómitos).
- Hacer, 1-2 horas después de instaurada la VMNI, gasometría arterial
- Si en 2-4 horas no hay una respuesta positiva clínica o gasométrica después de haber efectuado todos los ajustes y correcciones, considerar la intubación endotraqueal y ventilación mecánica invasiva, y, si no es posible, valorar cambios en el modo de VMNI

PROTOCOLO DE INSTAURACIÓN DE VMNI

POSICIÓN SEMISENTADO (45º)

MONITORIZAR: FC, PANI, SpO_2

SELECCIONAR VENTILADOR Y MODO

ELEGIR MÁSCARA

EXPLICAR PROCEDIMIENTO

PRESION MÍNIMA, NO ALARMAS

IPAP: 8 cmH_2O
EPAP: 4 cmH_2O
CPAP:5 cmH2O

APLICAR MÁSCARA CON MANO

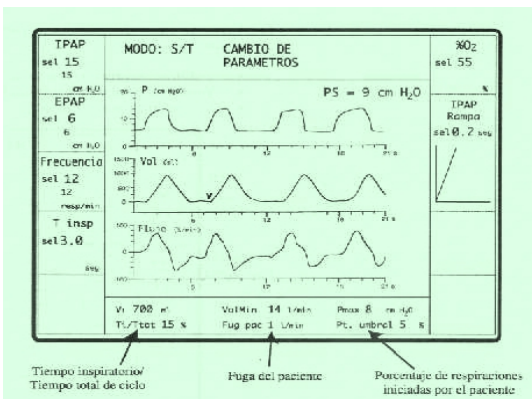
SUJETAR MÁSCARA CON ARNES
Proteger puente nasal

TITULAR IPAP (2/2): Comodidad del paciente,Vc=7-8 mL/kg, Fr=20-25 rpm.
TITULAR EPAP (2/2): Esfuerzo inspiratorio (compensar PEEPi), SpO_2>90%.
TRIGGER I: no autodisparo, ni fallo. TRIGGER E: 15-25% IRA, 25-40% EPOC
Tolerancia, disnea, actividad ECM.

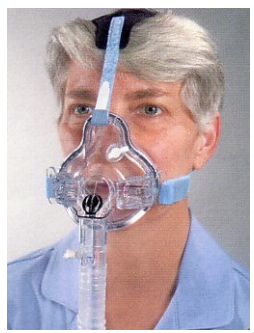
VIGILAR y CORREGIR: gases (1-2 horas) y preguntar mucho.

PROBLEMAS CLÍNICOS COMUNES EN VENTILACIÓN NO INVASIVA

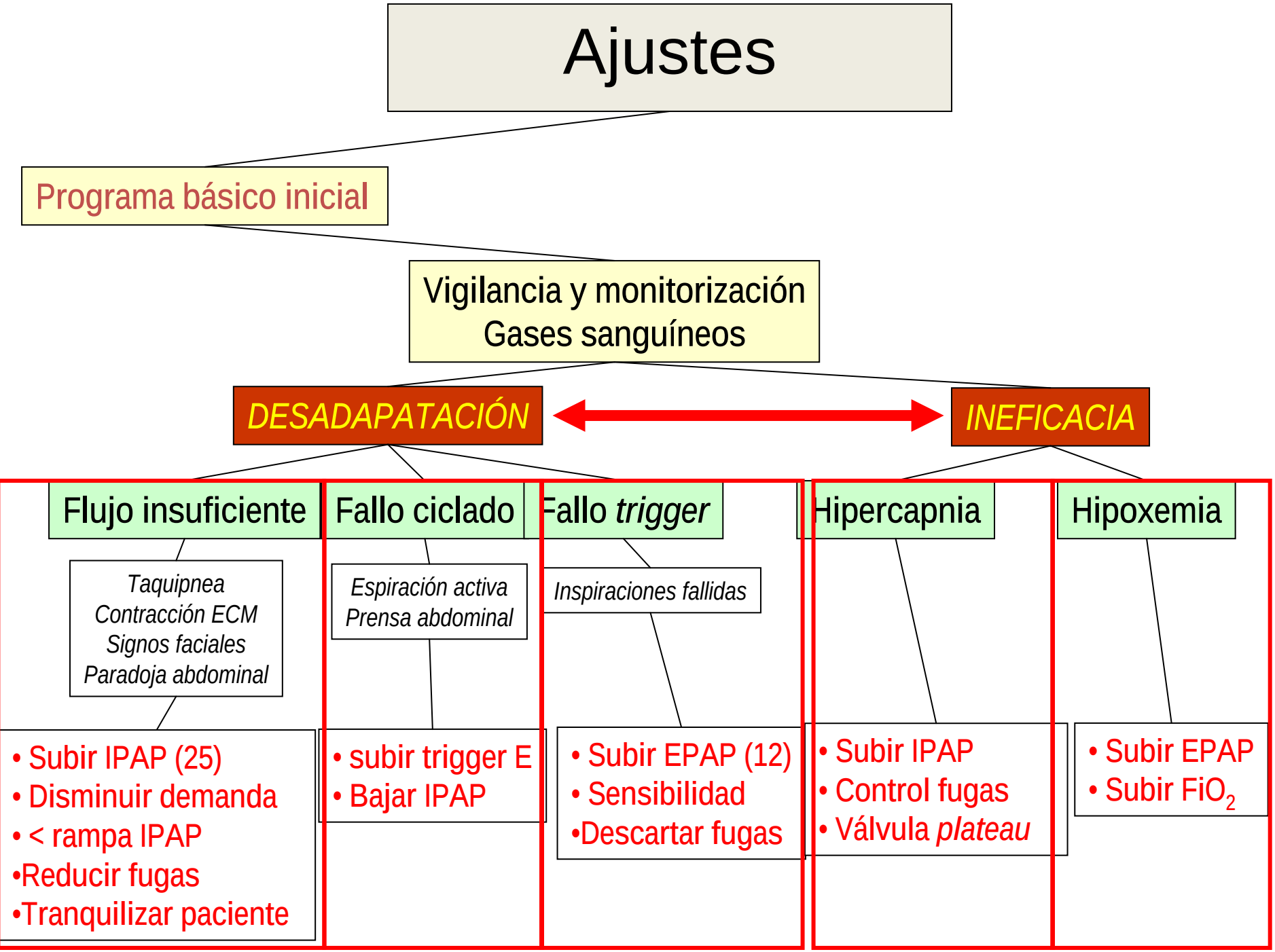
RESPIRADOR MODO DE VENTILACIÓN



INTERFASE MÁSCARA



PACIENTE


Ajustes
Programa básico inicial
Vigilancia y monitorización
Gases sanguíneos
DESADAPATACIÓN
INEFICACIA
Flujo insuficiente
Fallo ciclado
Fallo trigger
Hipercapnia
Hipoxemia
Taquipnea
Contracción ECM
Signos faciales
Paradoja abdominal
Espiración activa
Prensa abdominal
Inspiraciones fallidas
• Subir IPAP (25)
• Disminuir demanda
• < rampa IPAP
•Reducir fugas
•Tranquilizar paciente
• subir trigger E
• Bajar IPAP
• Subir EPAP (12)
• Sensibilidad
•Descartar fugas
• Subir IPAP
• Control fugas
• Válvula plateau
• Subir EPAP
• Subir FiO2

Caso VMNI: evolución

- A las 2
  60,4, pH
  con IPA

Día de ingreso / Hora	pH	pCO_2	pO_2	HCO_3	Saturación de oxiHg (%)	Observaciones
1º día 13:30 horas	7,19	84,6	163	30,9	98,2	Con mascarilla con reservorio
1º día 15:30 horas	7,30	66,4	59	31,7	90,4	Control tras 2 h con VMNI.
2º día	7,33	60,4	89	31,1	96,8	Gasometría de control .

PREGUNTAS

- Tratamiento broncodilatador
- Nutrición
- Criterios de retirada

Resto de tratamiento

- Nebulizar salbutamol/ipratropio de forma similar a pacientes sin VMNI
- Oxígeno por filtro
- Corticoides (40 mg prednisona/24 h)
- Antibióticos

NUTRICION

- En principio dejaremos en absoluta las primeras 24 horas
- Posteriormente dieta acorde con sus necesidades, con descenso progresivo antes de cada toma (2-4 cm/H2O cada 10 min hasta 8-10/4-6) y reinicio similar
- O2 por gafas durante la comida

RETIRADA VMNI

- No mejoría tras 2-4 horas de tratamiento:
  - pH<7,30, PaO2 <50 con FiO2 >50, Fr >30, disnea severa

- Deterioro: (criterios de intubación)
  - ❑ Parada respiratoria.
  - ❑ Disminución del nivel de conciencia: Glasgow < 9
  - ❑ Agitación psicomotriz
  - ❑ Frecuencia cardiaca < 50/min
  - ❑ Hipotensión con TAS < 90 mmHg
  - ❑ Pa02 < 50 a pesar de Fi02 > 50%
  - ❑ Incremento de la hipercapnia o deterioro pH<7,20
  - ❑ Secreciones bronquiales abundantes.
  - ❑ Frecuencia respiratoria > 40/min
  - ❑ Disnea no controlada
  - ❑ Incoordinación toraco-abdominal
  - ❑ Intolerancia a la mascarilla

RETIRADA VMNI

SOLUCIÓN O ESTABILIZACIÓN DE LA CAUSA Y:

- Estabilidad hemodinámica y clínica
- F. Respiratoria <30
- Pa/O2/FiO2 >200
- Ph>7,35
- No musculatura accesoria
- Mantenido con niveles iniciales de presión (descenso progresivo)

Caso VMNI: evolución

Día de ingreso / Hora	pH	pCO_2	pO_2	HCO_3	Saturación de oxiHg (%)	Observaciones
1º día 13:30 horas	7,19	84,6	163	30,9	98,2	Con mascarilla con reservorio
1º día 15:30 horas	7,30	66,4	59	31,7	90,4	Control tras 2 h con VMNI.
2º día	7,33	60,4	89	31,1	96,8	Gasometría de control .
6º día	7,39	61,9	80	36,9	94,4	Previa al alta.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Vivo 40
T
0 , 10 , 20 , 30 , 40
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para iniciar tratamient.
Modo
Config
Alarma
Otros
/


Muchas gracias