

Material suplementario

Ventilación mecánica en España, 1998-2016: epidemiología y desenlaces

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Tabla S1 - Variables registradas en cada estudio

	1998	2004	2010	2016
DEMOGRAPHIC VARIABLES				
Age	√	√	√	√
Sex	√	√	√	√
Weight	√	√	√	√
Height	-	√	√	√
Location prior to admission	√ (Home, street, other hospital, nursing home, other ICU within hospital, other ICU from other hospital)	-	-	-
Severity at admission (SAPS II)	√	√	√	√
Chronic functional status	√ (Dyspnea at rest, exertion dyspnea, neuro-motor disturbance, home oxygen, home mechanical ventilation)	-	√ (Non-invasive ventilation at home: No, CPAP, BiPAP)	√ (Non-invasive ventilation at home: No, CPAP, BiPAP)
Type of problem (medical/surgical)	√	√	-	-
Non-invasive ventilation at hospital prior to admission to intensive care unit	-	-	√ (yes / no)	√ (yes / no)
Arterial blood gases prior to start mechanical ventilation	√	√	√	√
Main indication for mechanical ventilation (yes /no)				
Chronic obstructive pulmonary disease	√	√	√	√
Asthma	√	√	√	√
Other chronic pulmonary disease	√	√	√	√
Acute respiratory failure				
Postoperative	√	√	√	√
Acute respiratory distress syndrome				
Cardiac failure	√	√	√	√
Pneumonia	√	√	√	√
Community acquired	-	√	√	√
Hospital acquired	-	√	√	√

	1998	2004	2010	2016
Sepsis	√	√	√	√
Trauma	√	√	√	√
Cardiac arrest	√	√	√	√
Aspiration	√	√	√	√
Other	√	√	√	√
Neurologic disease	√	√	√	√
Metabolic	-	√	√	√
Overdose- Intoxication	-	√	√	√
Hemorrhagic stroke	-	√	√	√
Ischemic stroke	-	√	√	√
Brain trauma	-	√	√	√
Other	-	√	√	√
Neuromuscular disease	-	√	√	√
MANAGEMENT VARIABLES				
First ventilatory support				
▪ Invasive	√	√	√	√
▪ Non-invasive				
Non-invasive positive pressure ventilation (NPPV)				
Type of device	√	√	√	√
Type of ventilator	-	-	√	√
Mode of NPPV	-	-	√	√
Intubation	√	√	√	√
	nasotracheal	(yes/no)	(yes/no)	(yes/no)
	orotracheal			
Mode of ventilation	√	√	√	√
Tidal volume (ml)	√	√	√	√
Respiratory rate (bpm)				
▪ Total	√	√	√	√
▪ Set Ventilator	√	-	√	√
FiO2	√	√	√	√
Applied Positive End-Expiratory Pressure	√	√	√	√
Permissive hypercapnia (yes / no)	√	-	-	-
Prone position (yes/no)	√	√	√	√
Hours of prone	-	-	√	√
Inhaled nitric oxide (yes / no)	√	-	-	-
ECMO	√	-	-	-
Sedation (continuous infusion at least 3 consecutive hours daily) (yes/no)	√	√	√	√
Benzodiazepines	√	-	√	√
Propofol (yes/no)	√	-	√	√
Doses of Midazolam	-	-	√	√
Doses of Lorazepam	-	-	√	√
Doses of Dexmedetomidine	-	-	√	√
Doses of Propofol	-	-	√	√
RASS	-	-	-	√
Daily Awakening (yes / no)	-	-	√	√
Analgesia (continuous infusion at least 3 consecutive hours daily) (yes/no)	√	-	√	√
Doses of Morphine	-	-	√	√

	1998	2004	2010	2016
Doses of Fentanyl	-	-	√	√
Doses of Remifentanyl	-	-	√	√
Doses of Sufentanyl	-	-	√	√
Neuromuscular blockers (continuous infusion at least 3 consecutive hours daily) (yes/no)	√	√	√	√
Vasoactive drugs (yes/no)	√	-	-	-
Steroids (prednisone equivalent daily doses)	-	-	√	√
Selective digestive decontamination (yes / no)	-	-	√	-
Intensive insulin therapy (yes / no)	-	-	√	√
MONITORING VARIABLES				
Arterial blood gases	√	√	√	√
SpO2	√	-	√	√
Peak pressure	√	√	√	√
Plateau pressure	√	√	√	√
Intrinsic positive end- expiratory pressure	√	-	-	-
Fluid balance	-	-	√	√
EVENTS DURING MECHANICAL VENTILATION				
Acute respiratory distress syndrome (yes / no)	√	√	√	√
Pulmonary	-	√	-	-
Extrapulmonary	-	√	-	-
Acute lung injury (yes/no)	-	√	-	-
Pulmonary	-	√	-	-
Extrapulmonary	-	√	-	-
Barotrauma (yes / no)	√	√	√	√
ICU acquired pneumonia (yes/no)	√	√	-	√
Fever (yes/no)	-	√	√	√
Leukocytosis (yes/no)	-	√	√	√
Chest x-ray infiltrates (yes/no)	-	√	√	√
Distribution infiltrates (unilateral, bilateral, unilobar)	-	√	-	-
Purulent secretions	-	√	√	√
Sepsis (yes/no)	√	√	√	√
Origin of sepsis	-	√	-	-
Shock / cardiovascular dysfunction (yes/no)	√	√	√	√
SOFA cardiovascular	-	√	√	√
Renal failure (yes/no)	√	-	-	-
Creatinine	-	√	√	√
Renal replacement (yes/no)	-	-	√	√
Oliguria (yes/no)	-	-	√	√
Hepatic failure (yes/no)	√	-	-	-
Bilirubin	-	√	√	√
Coagulopathy /Hematological failure (yes/no)	√	-	-	-
Platelet count	-	√	√	√
Glasgow Coma Scale	-	√	√	√

	1998	2004	2010	2016
ICU acquired weakness (yes/no)	-	-	√	√
Clinical criteria (yes/no)	-	-	√	-
Electromiographic criteria (yes/no)	-	-	√	-
Delirium (yes/no)	-	-	√	√
Intra-abdominal Hypertension (yes/no)	-	-	√	-
Abdominal Compartment Syndrome (yes/no)	-	-	√	-
VARIABLES RELATED WITH LIBERATION FROM MECHANICAL VENTILATION				
Start weaning (yes / no)	-	√	√	√
Finish weaning (yes/no)	-	√	√	√
Interrupted weaning (yes/no)	√	-	√	√
Method for first attempt				
Spontaneous Breathing Trial (yes/no)	√	√	√	√
Gradual reduction of support (yes/no)	√	√	√	√
Method of spontaneous breathing trial (T-piece, CPAP, Pressure support less than 7 cm of water, other)	√	√	√	√
Method for gradual reduction (pressure support, SIMV, SIMV-PS, other)	√	√	√	√
Monitoring at the start and at the end of first attempt				
Respiratory rate	-	-	√	
Tidal volume	-	-	√	
Heart rate	-	-	√	
Mean blood pressure	-	-	√	
Central venous pressure	-	-	√	
Pulmonary artery occlusion pressure	-	-	√	
Echocardiography measurements				
Left ventricular ejection fraction ratio E/A ratio E/e'	-	-	√	
Brain natriuretic peptide	-	-	√	
Failure first attempt (yes/no)	-	√	√	√
Reason for failure (increase work of breathing, hypoxemia, respiratory acidosis, decrease level of conscience, hemodynamic)	-	-	√	√
Method for weaning				
Spontaneous Breathing Trial (yes/no)	Daily method	√	√	√
Gradual reduction of support (yes/no)	for weaning mechanical ventilation	√	√	√
Method of spontaneous breathing trial in	T-piece, CPAP	√	√	√
	PS than 7 cm	(T-	(T-piece,	(T-piece,

	1998	2004	2010	2016
weaning	of water Flow-by Gradual reduction Pressure support SIMV SIMV-PS	piece, CPAP, PS less than 7 cm of water, other)	CPAP, PS less than 7 cm of water, other)	CPAP, PS less than 7 cm of water, other)
Method for gradual reduction in weaning		√ (PS, SIMV, SIMV-PS, other)	√ (PS, SIMV, SIMV-PS, other)	√ (PS, SIMV, SIMV-PS, other)
Arterial blood gases pre-extubation	-	-	-	√
Extubation				
Scheduled	√	√	√	√
Unplanned	√	√	√	√
Noninvasive positive pressure ventilation post-extubation (yes/no)	-	√	√	√
Preventive	-	-	√	√
Treatment	-	-	√	√
High-Flow therapy post- extubation (yes/no)	-	-	√	√
Preventive	-	-	-	√
Treatment	-	-	-	√
Reintubation (yes/no)	√	√	√	√
Time of reintubation (0-12 hours 12-24 hours 24-48 hours)	√	√	-	-
Reason for reintubation (upper airway obstruction, secretions, increase work of breathing, congestive heart failure, decrease level of conscience)	-	-	√	√
Tracheotomy (yes/no)	√	√	√	√
Method for tracheotomy (surgical/percutaneous)	-	√	√	√
OUTCOMES				
Status at discharge from intensive care unit (alive/dead)	√	√	√	√
Status at discharge from hospital (alive/dead)	√	√	√	√
Decision of withholding / withdrawal (yes / no)	-	-	√	√
Destiny	√ (home, nursing home, acute facility, chronic ventilatory, other)	-	√ (home, chronic ventilator unit, nursing home, other acute hospital.)	√ (home, chronic ventilator unit, nursing home, other acute hospital)
REGISTERED DATES				
Date of admission to hospital	√	√	√	√
Date of admission to	√	√	√	√

	1998	2004	2010	2016
intensive care unit				
Date of admission to intensive care unit	√	√	√	√
Date of start mechanical ventilation	√	√	√	√
Date of intubation	√	√	√	√
Date of start withdrawal mechanical ventilation	√	-	-	-
Date of intubation	√	√	√	√
Date of start withdrawal mechanical ventilation	√		-	-
Date of met criteria to withdrawal mechanical ventilation	-	√	-	-
Date of first attempt with spontaneous breathing trial	-	√	√	√
Date of first attempt with gradual reduction of support	-	√	√	√
Date of first extubation	√	√	√ (date and time)	√ (date and time)
Date of reintubation	-		√ (date and time)	√ (date and time)
Date of second extubation	√	--	-	-
Date of tracheostomy	√	√	√	√
Date of discharge from intensive care unit	√	√	√	√
Date of discharge from hospital	√	√	√	√
Date of withholding / withdrawal decision	-	-	√	√

Tabla S2 - Definiciones operativas

Acute exacerbation of COPD	Patient had the diagnosis of COPD and had an exacerbation that required mechanical ventilation
Asthma	Mechanical ventilation started because of status asthmaticus and/or acute exacerbation in a patient with prior history of reactive airway disease
Other chronic pulmonary disease	Patient with diagnosis of chronic respiratory disease other than COPD or asthma (eg, pulmonary fibrosis)
Acute respiratory distress syndrome	Based on the criteria established by the American-European Consensus Conference: acute onset, Pao ₂ /Fio ₂ < 200, bilateral infiltrate on chest radiograph, absence of heart failure
Postoperative acute respiratory failure	Patients who underwent surgery and were not weaned from mechanical ventilation because of obesity, abdominal or thoracic surgery, advanced age, and so forth. Prior to surgery patients had not been on mechanical ventilation
Acute pulmonary edema and/or congestive heart failure	Patients with (1) acute cardiogenic pulmonary edema, (2) congestive heart failure with severe dyspnea with or without radiologic infiltrate, (3) cardiogenic shock
Aspiration	Patients who had gastric contents in their airway or tracheal aspirate
Pneumonia	Patients with a new radiographic alveolar infiltrate or worsening of previous alveolar infiltrate associated with fever/hypothermia and leukocytosis/leucopenia
Sepsis	Based on the criteria established by Consensus Conference on Sepsis by American College of Chest Physicians/Society of Critical Care Medicine: systemic inflammatory response syndrome (hyperthermia/hypothermia, tachycardia, tachypnea, leukocytosis/leukopenia) secondary to infection
Trauma	Mechanical ventilation because of chest, abdominal, or multiple trauma (this category did not include patients with only brain trauma)
Cardiac arrest	Mechanical ventilation because of sudden and unexpected cessation of cardiopulmonary functions
Neurologic disease	Mechanical ventilation because a decrease in the level of conscience due to metabolic encephalopathy, overdose/intoxication, stroke or brain trauma.
Neuromuscular disease	Respiratory failure due to primary impairment of peripheral neurologic system, muscle mass, and/or motor plaque
ICU-acquired pneumonia	Modified Centers for Disease Control and Prevention criteria which require a new radiographic infiltrate persistent for 48 hours or more plus a body temperature more than 38.5°C or less than 35.0°C, a leukocyte count of more than 10000/μL or less than 3000/μL, purulent sputum or change in character of sputum, or isolation of pathogenic bacteria from an endotracheal aspirate.
Cardiovascular failure / shock	Mean arterial pressure is lower than 70 mm Hg during 2 consecutive hours and patient is receiving vasoactive drugs.
Acute renal failure	Defined as an acute increase in creatinine of more than 2 mg/dL (177 μmol/L), double the baseline value in a patient with underlying chronic renal failure, and/or the need for acute hemodialysis or acute use of any form of dialysis.
Hepatic failure	Defined as an acute change in bilirubin to more than 2 mg/dL (34 μmol/L)
Hematologic failure / coagulopathy*	Defined as a decrease in the platelet count of 25% or more from the baseline or a platelet count lower than 50000 cells/microliter.
Sedation	It will be considered <u>yes</u> when patient received a

	continuous infusion for more than three consecutive hours
Polyneuropathy / myopathy critical illness	Clinical sign of flaccid and symmetrical weakness.and reduction or absence of deep tendon reflexes
Delirium	To consider <u>yes</u> if: <ul style="list-style-type: none">• Richmond Agitation and Sedation Scale between -3 and + 4 AND• Acute changes in mental status AND• Inattention AND• Disorganized Thinking OR Altered Level of Consciousness
Abdominal compartment syndrome	Intra-abdominal pressure higher than 20 mmHg with organ failure secondary to intra-abdominal hypertension

Tabla S3 - Características de los enfermos que son tratados con ventilación no invasiva como primer soporte ventilatorio

	1998 (N=44)	2004 (N=91)	2010 (N=322)	2016 (N=196)
Edad, media (DE), años	64(14)	65(15)	67(14)	66(15)
Mujeres, n (%)	14(32)	34(37)	119(37)	73(37)
Simplified Acute Physiology Score II (SAPS II), media (DE), puntos	35(13)	36(14)	42(15)	41(15)
Ventilación no invasiva previa, n (%)				
Domiciliaria	5 (11)	n.r.	29 (9)	18 (9)
Previa al ingreso en la UCI	n.r.	n.r.	51 (16)	30 (15)
Motivo de inicio de la ventilación mecánica, n, (%)				
Enfermedad pulmonar obstructiva crónica	19 (43)	23 (25)	63 (20)	32 (16)
Asma	1 (2)	2 (2)	6 (2)	6 (3)
Otra Enfermedad pulmonar crónica	1 (2)	6 (6)	11 (3)	10 (5)
Síndrome de distrés respiratorio agudo	5 (11)	4 (4)	16 (5)	11 (6)
Insuficiencia respiratoria postoperatoria	1 (2)	3 (3)	13 (4)	5 (3)
Insuficiencia cardiaca	4 (9)	21 (23)	100 (31)	60 (30)
Aspiración	-	1 (1)	3 (1)	2 (1)
Neumonía	10 (23)	19 (21)	59 (18)	43 (22)

	1998 (N=44)	2004 (N=91)	2010 (N=322)	2016 (N=196)
Sepsis	1 (2)	3 (3)	2 (1)	1 (0,5)
Trauma	2 (4)	-	8 (2)	5 (3)
Otra causa de insuficiencia respiratoria aguda	1 (2)	6 (6)	-	11 (5)
Patología neurológica	-	1 (1)	4 (1)	10 (5)
Enfermedad neuromuscular	1(2)	2 (2)	-	-
Orden de no intubación	n.r.	n.r.	7 (2)	-
Otro motivo	n.r.	n.r.	30 (9)	n.r.
Gases arteriales previos al inicio de la ventilación no invasiva				
pH, media (DE)	n.r.	7,29 (0,11)	7,30 (0,11)	7,30 (0,10)
PaCO ₂ , media (DE), mmHg,	n.r.	58 (22)	57 (27)	55 (21)
Relación PaO ₂ /FiO ₂ , media (DE)	n.r.	155 (98)	145 (89)	146 (77)
Duración de la ventilación no invasiva, mediana (P ₂₅ , P ₇₅), horas	n.r.	36 (17,88)	23 (9, 60)	27 (19, 51)
Fracaso de la ventilación no invasiva, n (%)	14 (32)	37 (41)	86 (27)	60 (31)

Tabla S4 - Análisis descriptivo de la mortalidad en la UCI

	1998	2004	2010	2016
Área geográfica				
Andalucía	31%	30%	32%	28%
Aragón	55%	37%	23%	20%
Asturias	17%	36%	25%	34%
Canarias	27%	-	25%	29%
Castilla-La Mancha	27%	36%	24%	21%
Castilla-León	30%	36%	27%	28%
Catalunya	29%	31%	23%	22%
Extremadura	-	-	33%	33%
Galicia	35%	33%	21%	22%
Illes Balears	33%	39%	24%	29%
Madrid	38%	29%	25%	31%
Murcia	37%	29%	34%	26%
Norte (Cantabria, Euskadi, La Rioja, Navarra)	32%	31%	23%	29%
Valencia	42%	48%	32%	23%
Edad, media (DE), años				
Fallecidos	62 (14)	63 (15)	66 (15)	66 (15)
Vivos	59 (17)	58 (17)	61 (16)	62 (16)
Mujeres vs. Hombres, % Mortalidad	33 %/ 33%	29%/ 36%	25% / 28%	31% / 25%
SAPS II, media (DE), puntos				
Fallecidos	50 (17)	50(17)	55 (18)	57 (19)
Vivos	41 (16)	39 (15)	43 (16)	43 (16)
Motivo de inicio de la ventilación mecánica, % Mortalidad				
Enfermedad pulmonar obstructiva crónica	20%	11%	21%	11%
Asma	10%	0%	0%	8%
Otra Enfermedad pulmonar crónica	37%	33%	20%	30%

	1998	2004	2010	2016
Síndrome de distrés respiratorio agudo	67%	45%	49%	46%
Insuficiencia respiratoria postoperatoria	26%	14%	15%	14%
Insuficiencia cardiaca	25%	26%	22%	16%
Aspiración	30%	36%	24%	28%
Neumonía	54%	57%	27%	27%
Sepsis	53%	52%	37%	37%
Trauma	19%	4%	13%	18%
Parada cardiaca	33%	59%	48%	56%
Otra causa de insuficiencia respiratoria aguda	40%	25%	28%	36%
Patología neurológica	37%	38%	29%	32%
Enfermedad neuromuscular	9%	17%	17%	17%
Soporte ventilatorio inicial				
No invasiva				
Éxito	13%	4%	12%	7%
Fracaso	71%	51%	57%	33%
Invasivo	33%	36%	28%	30%
Complicaciones durante la ventilación mecánica, %				
Mortalidad				
Síndrome de distrés respiratorio agudo	72%	62%	50%	58%
Neumonía asociada a la ventilación	37%	54%	25%	67%
Sepsis	60%	50%	37%	34%
Disfunción cardiovascular	59%	49%	37%	34%
Disfunción renal	71%	53%	46%	42%

	1998	2004	2010	2016
Disfunción hepática	83%	67%	51%	59%
Disfunción hematológica	65%	61%	56%	51%