The 38th KTCVS Spring Meeting 2024 SEOUL
The 4th AAPCHS May 31st - June 1st Seoul Dragon City Hotel

DKU Trauma Center
Our Mission Your life

Ventilator Strategies for Trauma

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Dankook University, Collage of Medicine, Cheonan, Korea

No

Conflict of Interest

Contents

Respiration

- Provide O2 to the tissues and to remove the CO2
  - Breathing (ventilation) :
  - External respiration :

    air and blood
  - Internal respiration :

    blood and tissues
- **Cellular respiration : produce ATP(energy)**

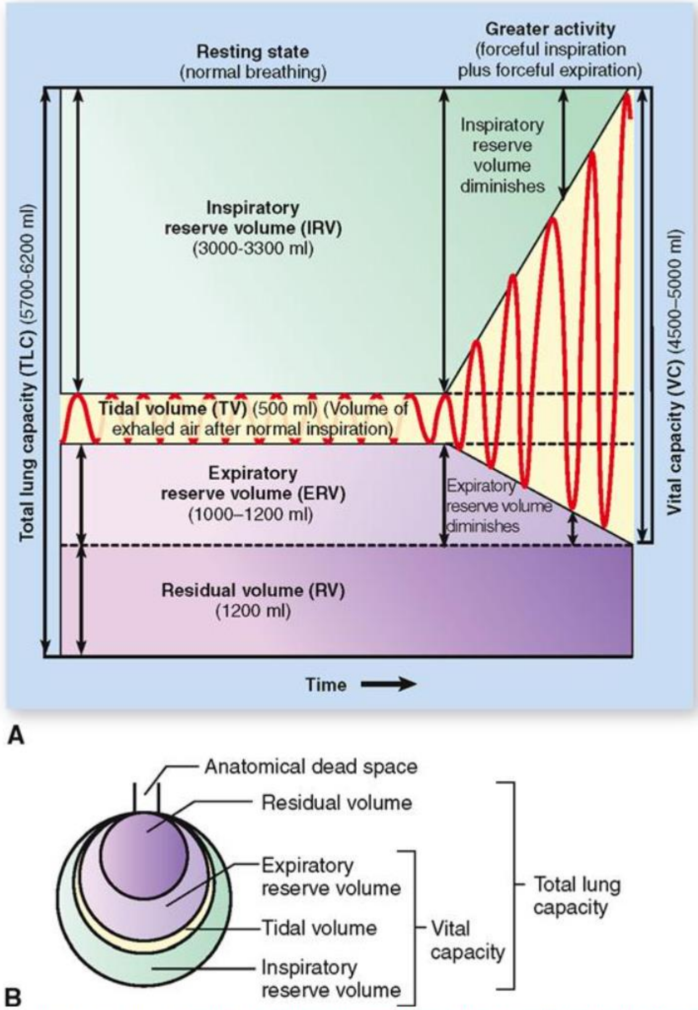


FIGURE 27-11 Pulmonary ventilation volumes and capacities. A, Spirogram. B, Pulmonary volumes (at rest) represented as relative proportions of an inflated balloon. During normal, quiet respirations, the atmosphere and lungs exchange about 500 ml of air (TV). With forcible inspiration, about 3300 ml more air can be inhaled (IRV). After a normal inspiration and normal expiration, approximately 1000 ml more air

Respiratory system

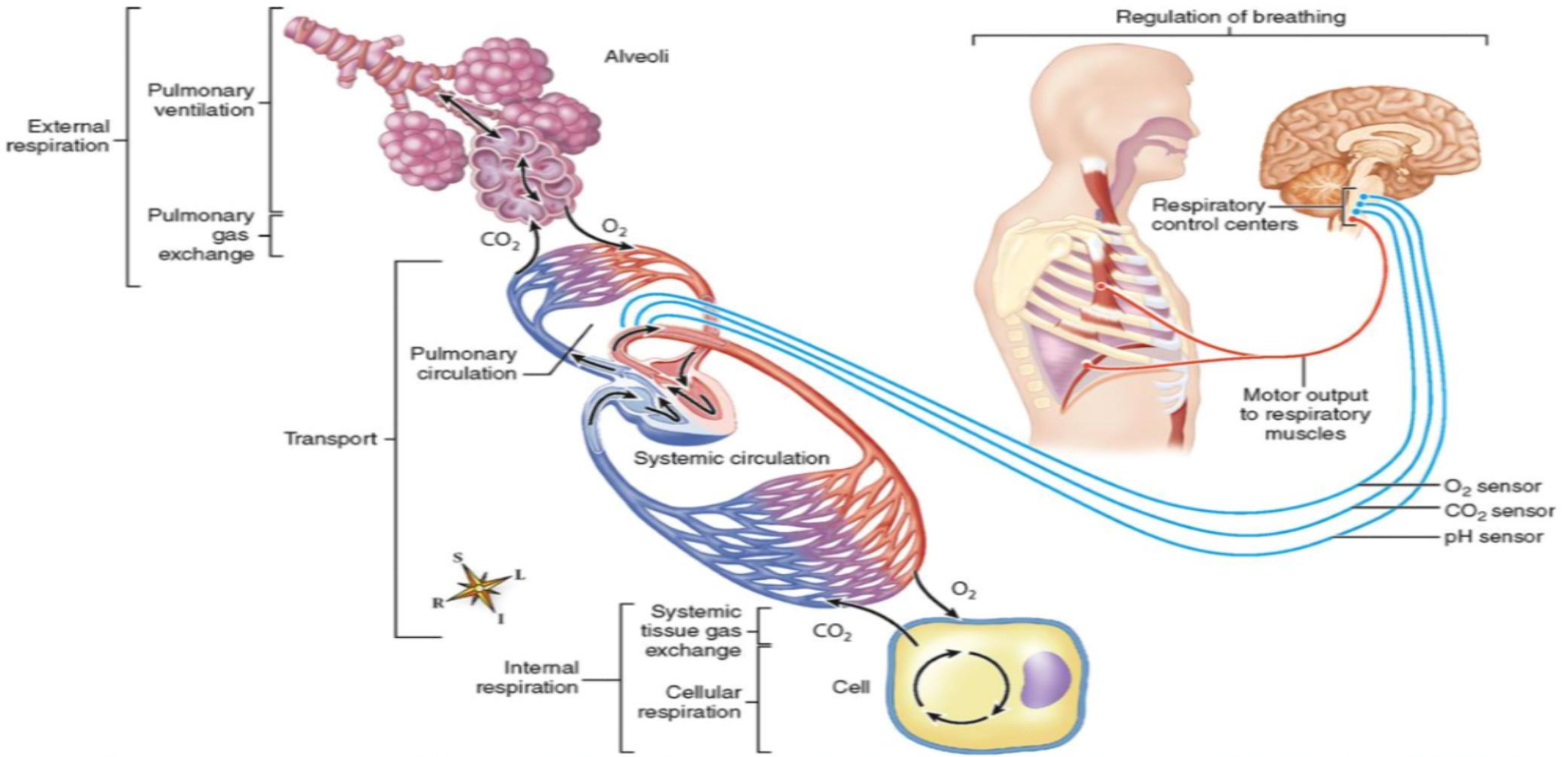
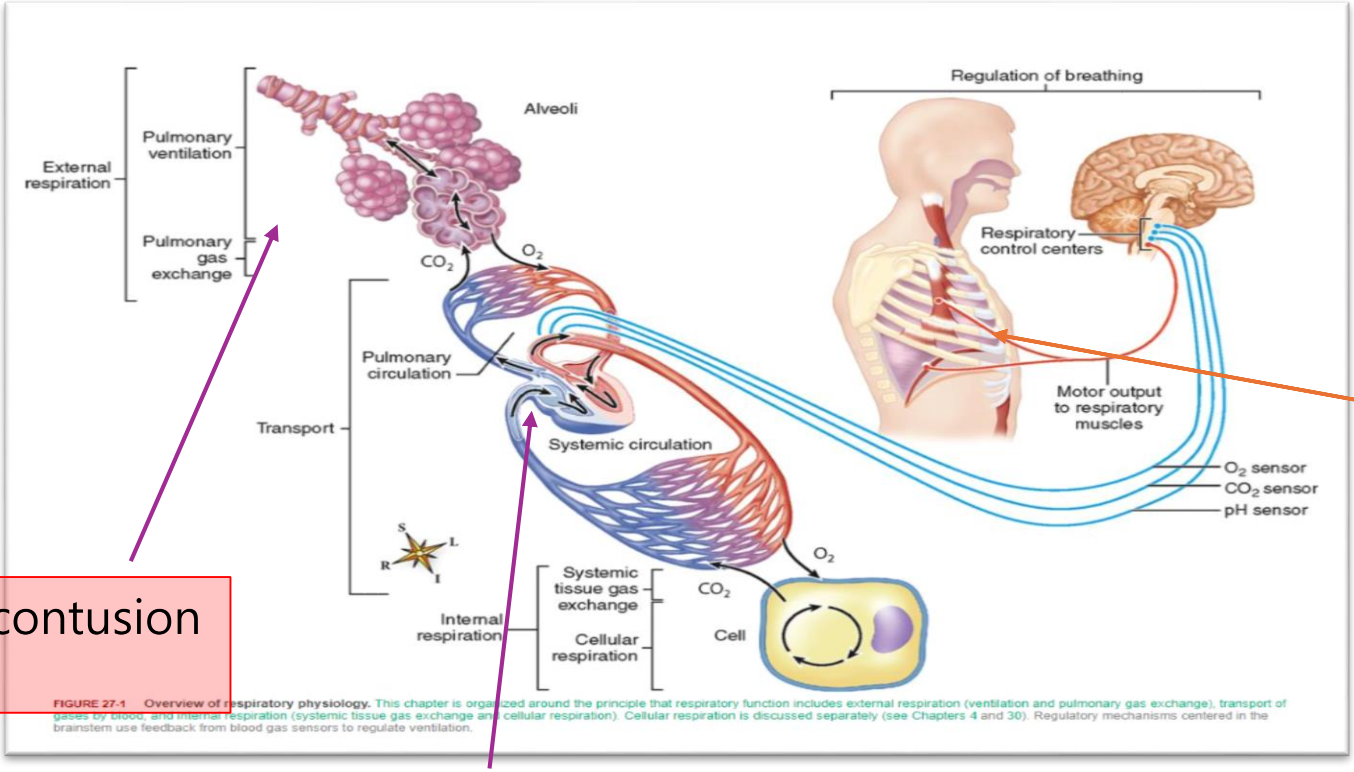


FIGURE 27-1 **Overview of respiratory physiology.** This chapter is organized around the principle that respiratory function includes external respiration (ventilation and pulmonary gas exchange), transport of gases by blood, and internal respiration (systemic tissue gas exchange and cellular respiration). Cellular respiration is discussed separately (see Chapters 4 and 30). Regulatory mechanisms centered in the brainstem use feedback from blood gas sensors to regulate ventilation.

Trauma impact to respiration system



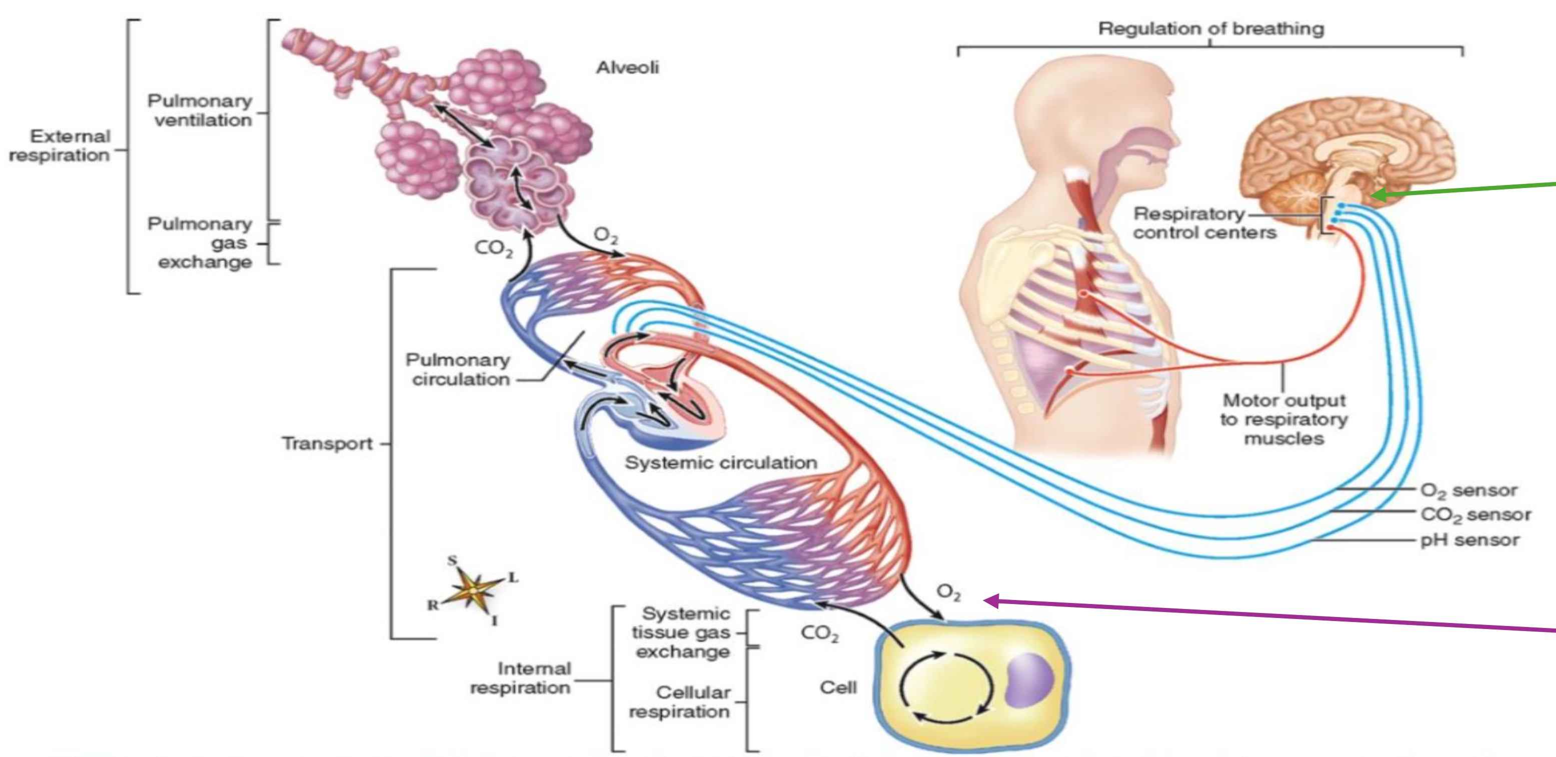
- Pulmonary contusion
- Mucus plug

- Chest wall injury
  MRF, Flail chest
- Hemothorax,
  Pneumothorax

- Traumatic Cardiac Contusion
- Congestive Heart Failure
- COPD

Direct chest injury leading to functional impairment of one or both lungs

Trauma impact to respiration system



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- Traumatic brain injury
- Cervical cord injury
- Facial Trauma
- Long bone fractures

- Hypovolemic shock
- SIRS or DAMP
- MOF

Indirect injury via a multi-factorial inflammatory—mediated response to severe extrathoracic injury.

Table 1 General causes of systemic hypoxia

Cause of hypoxia	Impairment	Examples
Hypoxaemic	Gas transport to, or across, the alveoli	Low atmospheric oxygen tension (e.g. altitude) Obstructive lung disease (e.g. asthma, chronic obstructive pulmonary disease) Restrictive lung disease (e.g. fibrosis) Pulmonary oedema Pulmonary consolidation Acute respiratory distress syndrome
Circulatory/stagnant	Transport of oxygen from the alveoli to tissues	Hypovolaemia Cardiogenic shock Distributive shock (e.g. septic, anaphylactic) Obstructive shock (e.g. cardiac tamponade, tension pneumothorax, massive pulmonary embolism)
Anaemic	Oxygen carrying capacity of blood	Low haemoglobin concentration (e.g. iron deficiency, folate deficiency) Genetic haemoglobinopathies (e.g. thalassaemias)
Histotoxic	Oxygen utilisation at cellular level	Cellular dysfunction (e.g. sepsis) Cyanide (mitochondrial complex IV inhibitor) Carbon monoxide poisoning

Goal of Mechanical Ventilation in Trauma

- To maintain gas exchange, to reduce or substitute respiratory effort
- To diminish the consumption of systemic and/or myocardiac O2
- To obtain lung expansion
- To allow sedation, anesthesia and muscle relaxation
- To stabilize the thoracic wall
- To avoid hypoxia and secondary tissue injury

Mechanical Ventilation in Trauma

ORIGINAL RESEARCH | Open Access

Predictors of pulmonary failure following severe trauma: a trauma registry-based analysis

Emanuel V Geiger[1*], Thomas Lustenberger[1], Sebastian Wutzler[1], Rolf Lefering[2], Mark Lehnert[1], Felix Walcher[1], Helmut L Laurer[1], Ingo Marzi[1] and TraumaRegister DGU®

Table 4 List of independent predictors for pulmonary failure as dependent variable in multivariate logistic regression analysis

Risk factor	p-value	Odds ratio (CI_{95})
Lung injury (AIS_{thorax} ≥3)	<0.0001	1.961 (1.745-2.205)
Male gender	<0.0001	1.654 (1.460-1.874)
PMCs	<0.0001	1.581 (1.401-1.784)
Transfusion of ≥10 PRBC	<0.0001	1.418 (1.190-1.690)
Administration of PRBC	<0.0001	1.386 (1.228-1.564)
Glasgow coma scale ≤ 8	<0.0001	1.273 (1.126-1.439)
ISS per point	<0.0001	1.027 (1.022-1.032)
Age per year	<0.0001	1.015 (1.012-1.017)

Abbreviations: *PMC*, pre-existing medical condition; *PRBC*, Packed Red Blood Cells; *ISS*, Injury Severity Score.

Mechanical Ventilation in Trauma

Injury 55 (2024) 111194

Contents lists available at ScienceDirect

Injury

journal homepage: www.elsevier.com/locate/injury

Early risk factors for prolonged mechanical ventilation in patients with severe blunt thoracic trauma: A retrospective cohort study

Aran Gilaed [a,1], Nadeem Shorbaji [b,1], Ori Katzir [c,1], Shaked Ankol [d], Karawan Badarni [e], Elias Andrawus [e], Michael Roimi [e], Amit Katz [a], Yaron Bar-Lavie [d,e], Aeyal Raz [d,f], Danny Epstein [e,*]

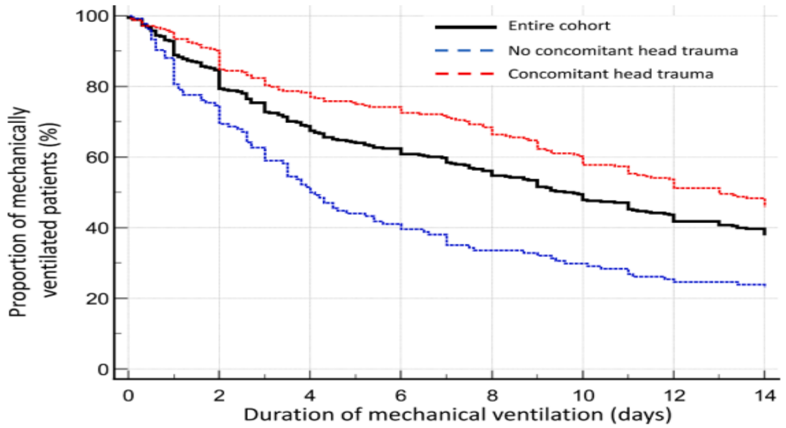

Fig. 2. Kaplan–Meier survival curve for 14-days mechanical ventilation dependency according to presence of severe head injury.

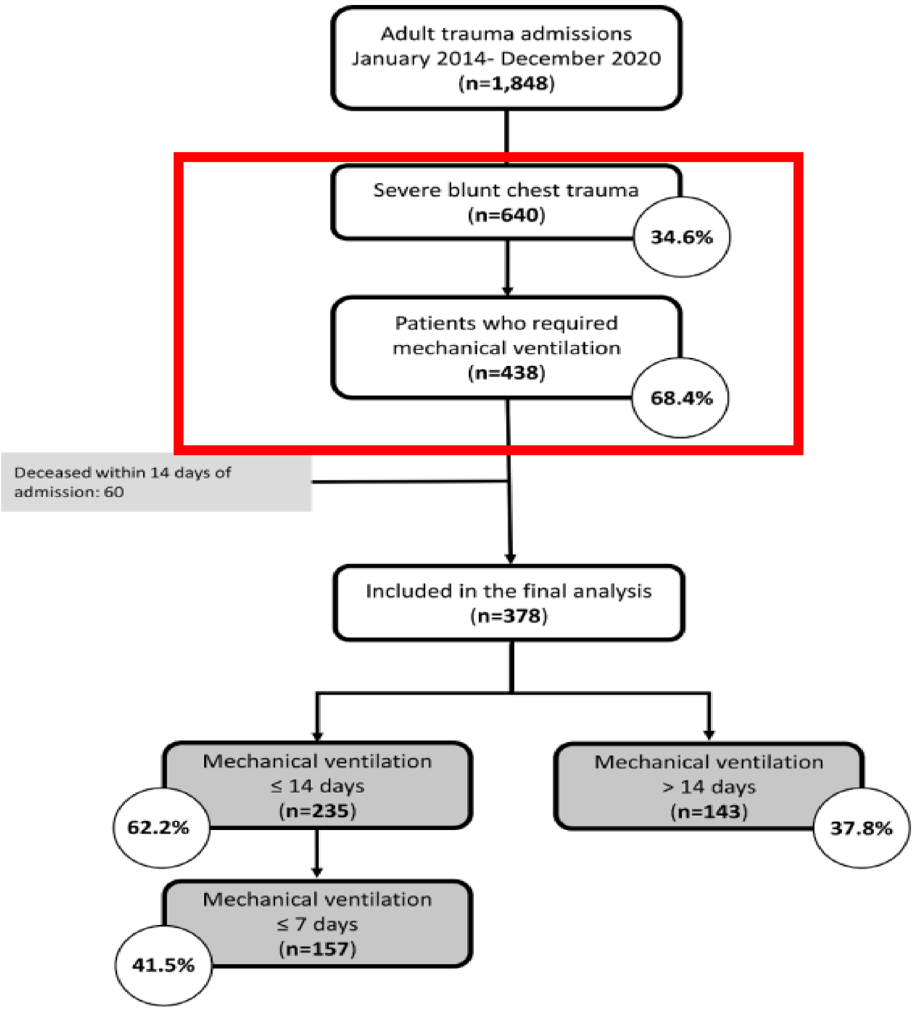

Fig. 1. Study flow-chart.

Mechanical Ventilation in Trauma

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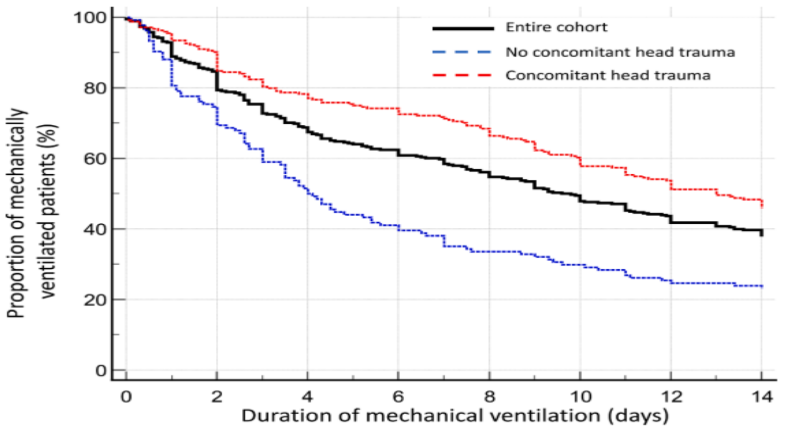


Fig. 2. Kaplan–Meier survival curve for 14-days mechanical ventilation dependency according to presence of severe head injury.

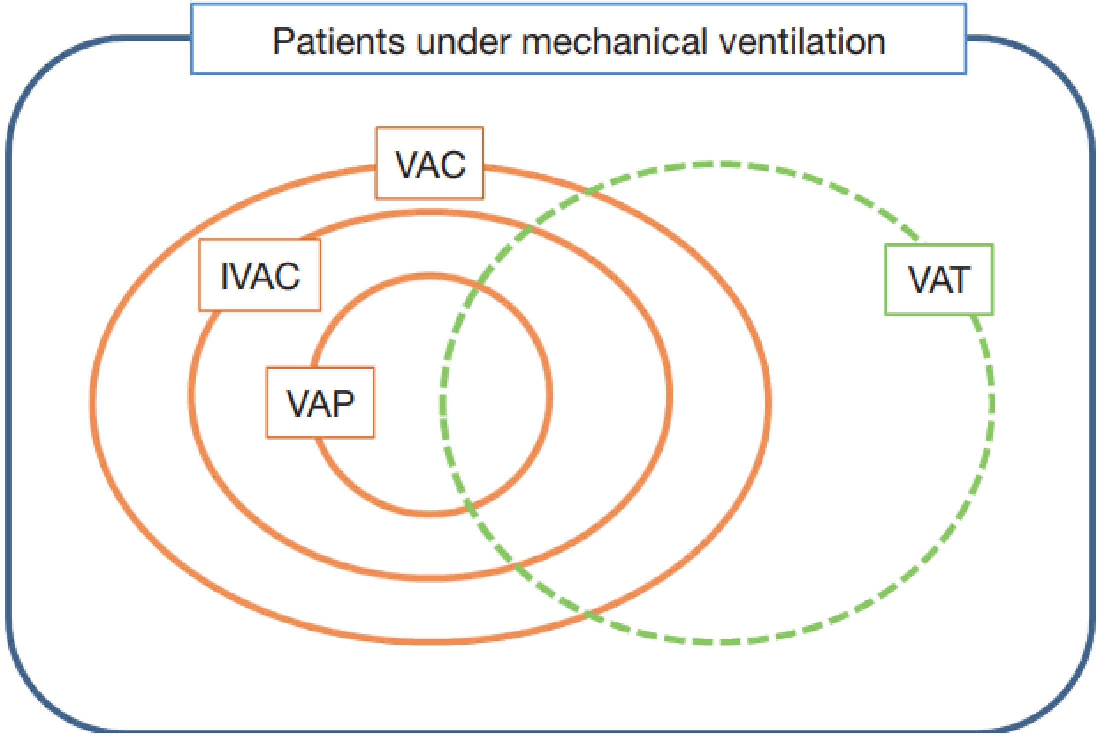
Conclusions

In summary, among patients with severe blunt thoracic injury (defined by chest AIS $\geq$3), older age, male gender, concomitant severe head trauma, and transfusion of >5 blood units on admission were independently associated with prolonged MV. Among patients without concomitant TBI, age, respiratory comorbidities, p/f ratio during the first 24 h, and transfusion of >5 blood units on admission were associated with prolonged MV. Young patients suffering from isolated severe thoracic trauma, including those with extensive lung contusions and rib fractures, have a low risk of prolonged MV.

Several Consideration in prolonged Mechanical Ventilation

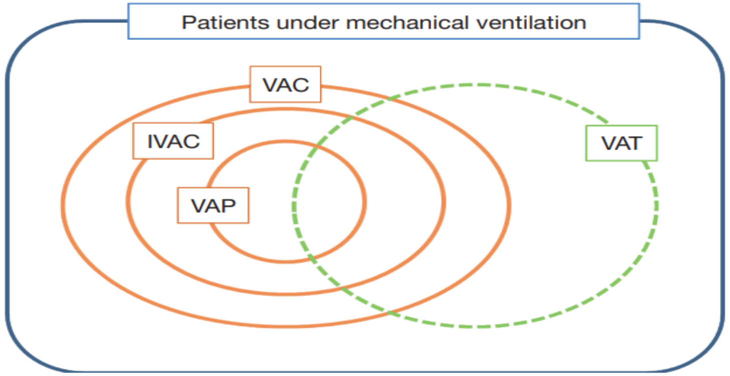
Ventilator induced Events

- > 20% FiO2
- > 3 cm H_2O PEEP



VAC : Ventilator-associated condition
IVAC : Infection-related ventilator-associated complication
VAP : ventilator-associated pneumonia

Bundles : prevention Ventilator induced Events



- Appropriate analgesia and sedation (especially avoiding benzodiazepines)
- Daily interruption of sedation
- Early mobilization, with or without ambulation
- Deep venous thrombosis prophylaxis
- Gastrointestinal prophylaxis
- Balanced intravenous fluid administration

- Head of bed elevation (30 to 45 degrees)
- Mouth/endotracheal tube care (oral cleansing with chlorhexidine)
- Lung-protective ventilator strategies
- Early discontinuation of mechanical ventilation

Mechanism of Ventilator induced Lung Injury

Barotrauma : Damage secondary to high airway pressure (ie, pneumothorax or pneumomediastinum

Volutrauma: high Tv causing overdistention of alveoli

Atelectrauma : the shear and strain of collapsible lung units opening and closing

biotrauma : damage from the release of proinflammatory cytokines and immune-mediated injury that occurs when lung tissue is exposed to unphysiologic stress or strain

Lung Protective Ventilation

Limit	limit tidal volume (6-8 ml/kg x IBW)
Limit	limit end-inspiratory plateau pressure (Pplat) <30cm H_2O
Provide	provide adequate PEEP to keep the lung open and prevent alveolar collapse
Limit	limit FiO_2 as low as possible (PaO_2 of 60-80 mm Hg or oxygenation saturation ≥90%

Mechanical Ventilation –induced Diaphragm Dysfunction

ORIGINAL ARTICLE

Mechanical Ventilation–induced Diaphragm Atrophy Strongly Impacts Clinical Outcomes

Ewan C. Goligher[1,2,3,4], Martin Dres[5,6], Eddy Fan[1,2,4,7], Gordon D. Rubenfeld[1,4,7,8], Damon C. Scales[1,4,7,8], Margaret S. Herridge[1,2,4,9], Stefannie Vorona[2], Michael C. Sklar[5,10], Nuttapol Rittayamai[5], Ashley Lanys[5], Alistair Murray[2], Deborah Brace[2], Cristian Urrea[2], W. Darlene Reid[11], George Tomlinson[2], Arthur S. Slutsky[1,4,5], Brian P. Kavanagh[1,3,10,12], Laurent J. Brochard[1,4,5]*, and Niall D. Ferguson[1,2,3,4,7,9]*

[1]Interdepartmental Division of Critical Care Medicine, [3]Department of Physiology, [4]Department of Medicine, [7]Institute for Health Policy, Management, and Evaluation, [10]Department of Anesthesia, and [11]Department of Physical Therapy, University of Toronto, Toronto, Canada; [2]Division of Respirology, Department of Medicine, University Health Network and Mount Sinai Hospital, Toronto, Canada; [5]Keenan Centre for Biomedical Research, Li Ka Shing Knowledge Institute, St. Michael's Hospital, Toronto, Canada; [6]Respiratory and Critical Care Department, Groupe Hospitalier Pitié Salpêtrière Charles Foix, Assistance Publique Hôpitaux de Paris, Paris, France; [8]Department of Critical Care Medicine, Sunnybrook Health Science Centre, Toronto, Canada; [9]Toronto General Research Institute, Toronto, Canada; and [12]Department of Critical Care Medicine, Hospital for Sick Children, Toronto, Canada

REVIEW Open Access

Ventilator-induced diaphragm dysfunction: translational mechanisms lead to therapeutical alternatives in the critically ill

Check for updates

Oscar Peñuelas[1,2]*, Elena Keough[1], Lucía López-Rodríguez[1], Demetrio Carriedo[1], Gesly Gonçalves[1], Esther Barreiro[2,3,4] and José Ángel Lorente[1,2,5]

From The 3rd International Symposium on Acute Pulmonary Injury Translational Research, under the auspices of the: 'IN-SPIRES®'
Amsterdam, the Netherlands. 4-5 December 2018

- changes in diaphragm structure and function caused by mechanical ventilation are an important and potentially avoidable determinant of poor outcomes

VIDD is reported in up to 53% of mechanically ventilated patients within 24 h of intubation.

Mechanical Ventilation –induced Diaphragm Dysfunction

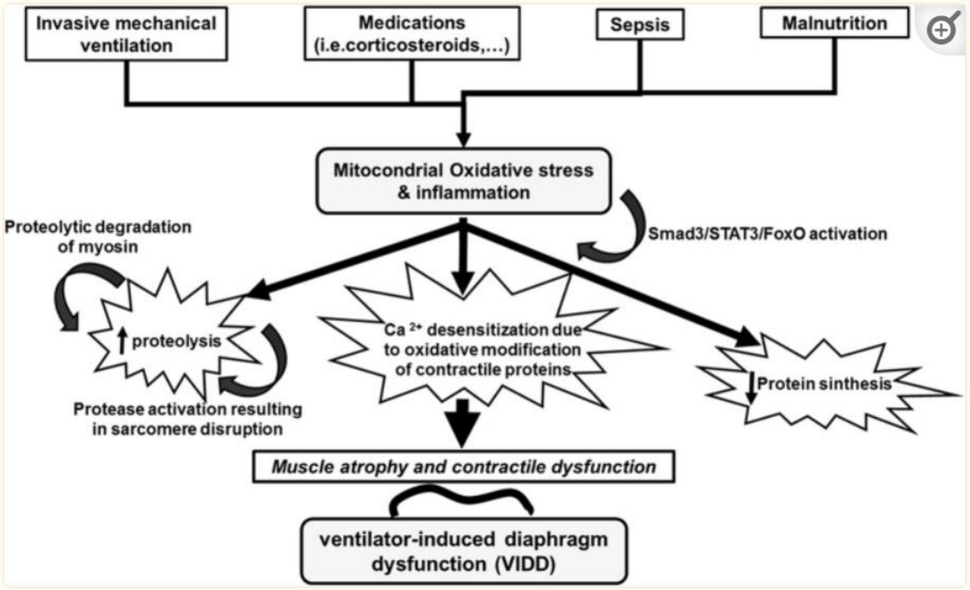


Fig. 1

Summary of the current understanding of the molecular pathways contributing to ventilator-induced diaphragm dysfunction (VIDD) in critically ill patients. As shown, different conditions can lead to diaphragm atrophy via an imbalance between proteolysis and protein synthesis [11, 14], whereas remaining muscle proteins may be impaired by enhanced oxidation and dephosphorylation [15–17]. Inflammation and oxidative stress are proposed to be the major drivers of these impairments [17]. In addition, certain drugs can impair neural drive and excitation-contraction coupling

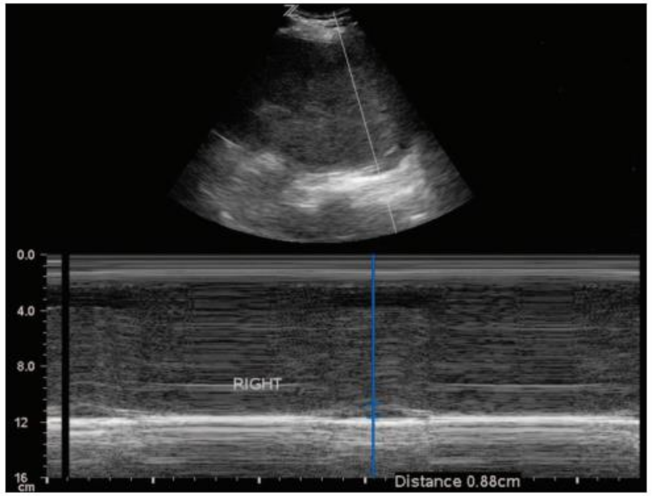


Fig. 1. B-mode was used to find the best approach and to select the exploration line of hemidiaphragm. During inspiration, diaphragmatic contraction was recorded by M-mode tracing, and the amplitude of excursion was measured on the vertical axis of the tracing from the baseline to the point of maximum height of inspiration on the graph.

Brief Report

A Trend towards Diaphragmatic Muscle Waste after Invasive Mechanical Ventilation in Multiple Trauma Patients—What to Expect?

Liliana Mirea [1,2], Cristian Cobilinschi [1,2,*], Raluca Ungureanu [1,2,*], Ana-Maria Cotae [1,2], Raluca Darie [1], Radu Tincu [1,3], Oana Avram [1,3], Sorin Constantinescu [4,5], Costin Minoiu [4,6], Alexandru Baetu [2,7] and Ioana Marina Grintescu [1,2]

Our current research suggests that diaphragmatic morphological changes may occur surprisingly faster after a relatively short duration of invasive mechanical ventilation in patients without any prior evidence of chronic comorbidities.

Mechanical Ventilation –induced Diaphragm Dysfunction

- spontaneous breathing as possible
- Optimizing sedation strategy
- Avoid prolonged use of muscle relaxants and steroids
- Inspiratory muscle training

Mechanical Ventilation –induced Diaphragm Dysfunction

Contents lists available at ScienceDirect
Journal of Critical Care
journal homepage: www.jccjournal.org

Effect of theophylline on ventilator-induced diaphragmatic dysfunction

Won-Young Kim, MD [a,1], So Hee Park, MD [a,1], Won Young Kim, MD, PhD [b], Jin Won Huh, MD, PhD [a], Sang-Bum Hong, MD, PhD [a], Younsuck Koh, MD, PhD [a], Chae-Man Lim, MD, PhD [a,*]

[a] *Department of Pulmonary and Critical Care Medicine, Asan Medical Center, University of Ulsan College of Medicine, Songpa-gu, Seoul, Republic of Korea*
[b] *Department of Emergency Medicine, Asan Medical Center, University of Ulsan College of Medicine, Songpa-gu, Seoul, Republic of Korea*

- Theophylline effect
- ✓ Heart muscle contractility and efficiency,
- ✓ Improves endurance and grip strength in patients with neuromuscular diseases
- ✓ Increases respiratory muscle activity such as intercostal muscle, transversus abdominis muscle, and diaphragm

The dose of theophylline was 200 (200-400) mg/d,

and the treatment duration was 12 (7-25) days

Patient Self-Inflicted Lung Injury

Journal of *Personalized Medicine*

MDPI

Review

Patient Self-Inflicted Lung Injury—A Narrative Review of Pathophysiology, Early Recognition, and Management Options

Peter Sklienka [1,2,3,*], Michal Frelich [1,2] and Filip Burša [1,2,3]

Patient Self-Inflicted Lung Injury

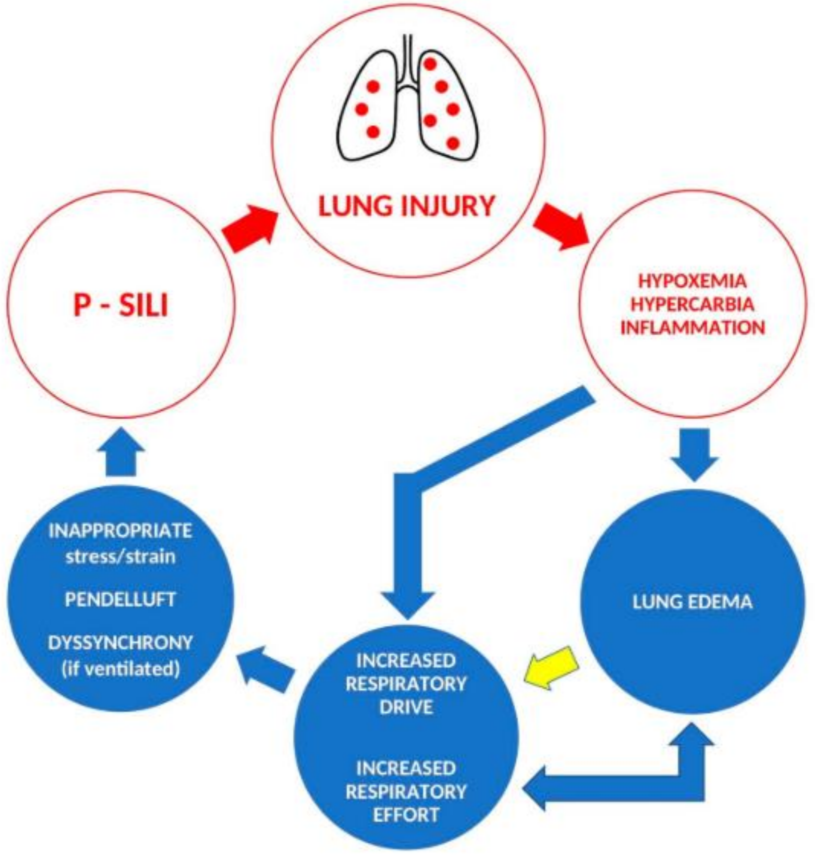


Figure 1. The pathophysiology of P-SILI—a "vicious circle" of self-aggravating lung injury; yellow arrow—vagal signalization (according to [5,10,18]).

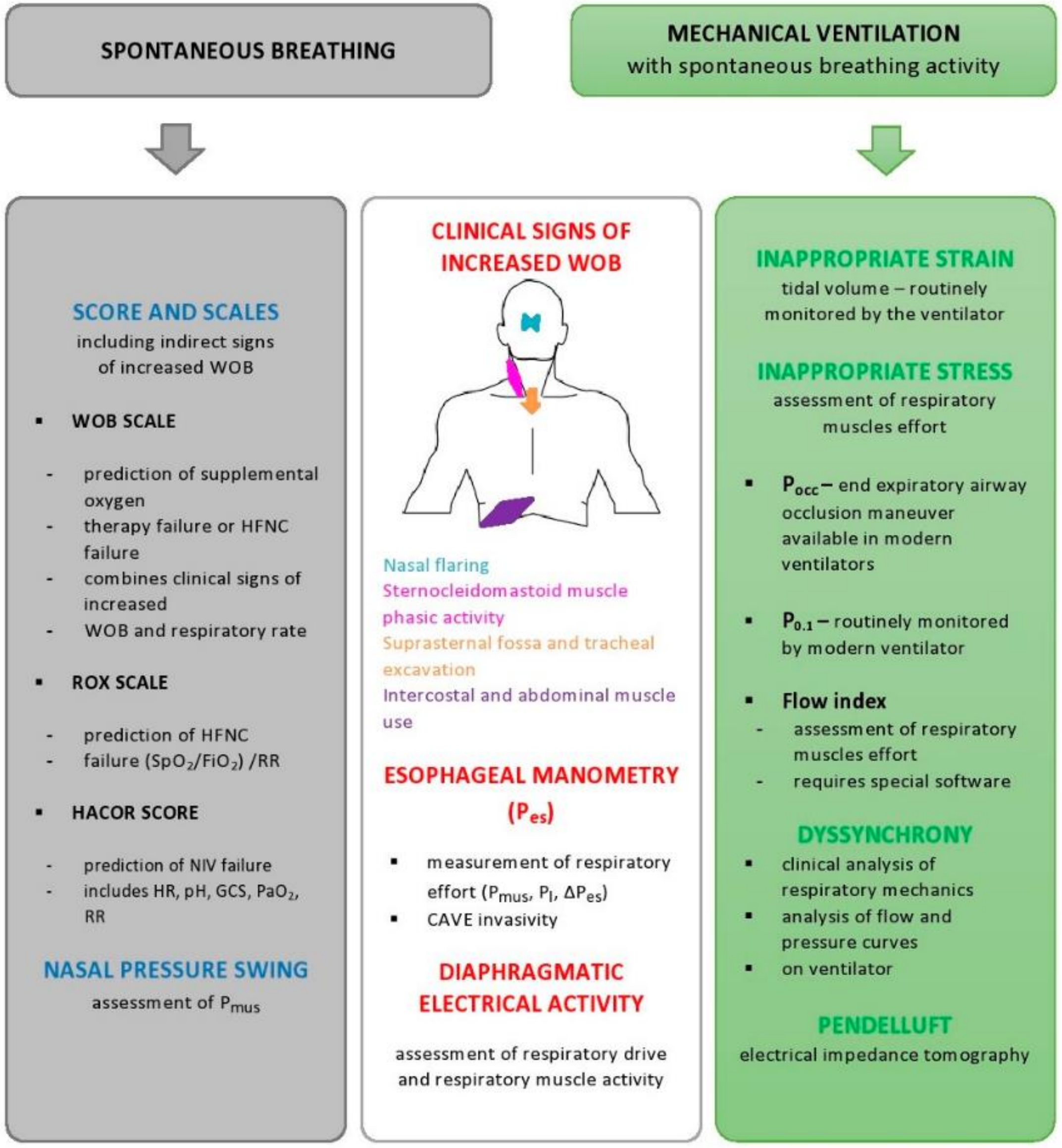


Figure 2. Noninvasive or minimally invasive bedside tools for detection of potentially injurious respiratory effort. Blue square—methods of indirect detection of vigorous spontaneous effort in

Patient Self-Inflicted Lung Injury

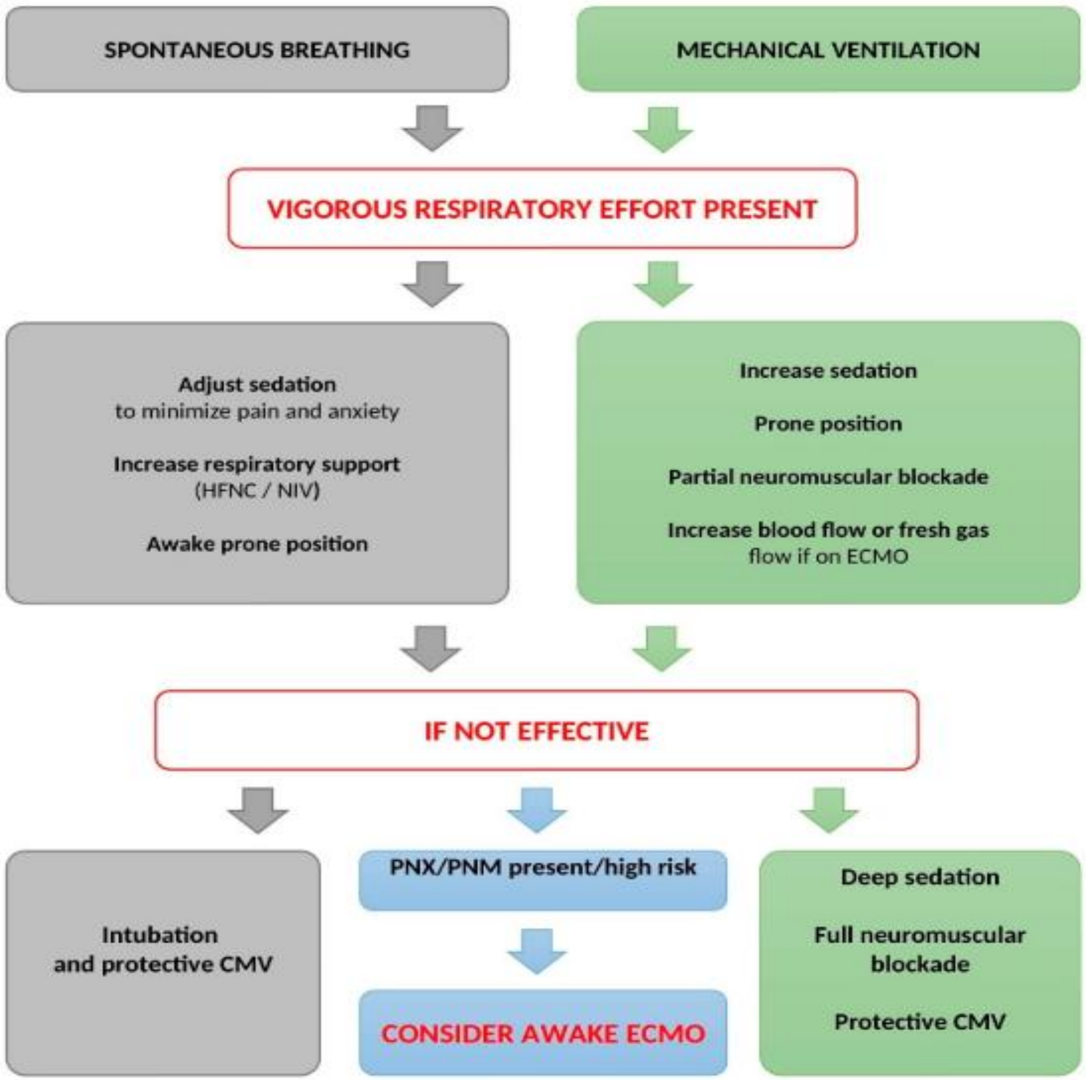


Figure 3. Proposal of an algorithm for P-SILI prevention and treatment. CMV—controlled mechanical ventilation; HFNC—high-flow nasal cannula; NIV—noninvasive ventilation; PNX—pneumothorax; PNM—pneumomediastinum; ECMO—extracorporeal membranous oxygenation.

Cardiac failure in Mechanical Ventilation

Deschamps *et al. Critical Care* (2020) 24:213
https://doi.org/10.1186/s13054-020-2823-9

Critical Care

RESEARCH Open Access

Brain natriuretic peptide to predict successful liberation from mechanical ventilation in critically ill patients: a systematic review and meta-analysis

Jean Deschamps[1*], Sarah K. Andersen[1], Jordan Webber[1], Robin Featherstone[2,3], Meghan Sebastianski[4], Ben Vandermeer[2,3], Janek Senaratne[5] and Sean M. Bagshaw[1]

RESEARCH **Open Access**

NT-proBNP change is useful for predicting weaning failure from invasive mechanical ventilation among postsurgical patients: a retrospective, observational cohort study

Yingying Zheng[1†], Zujin Luo[1†] and Zhixin Cao[1*]

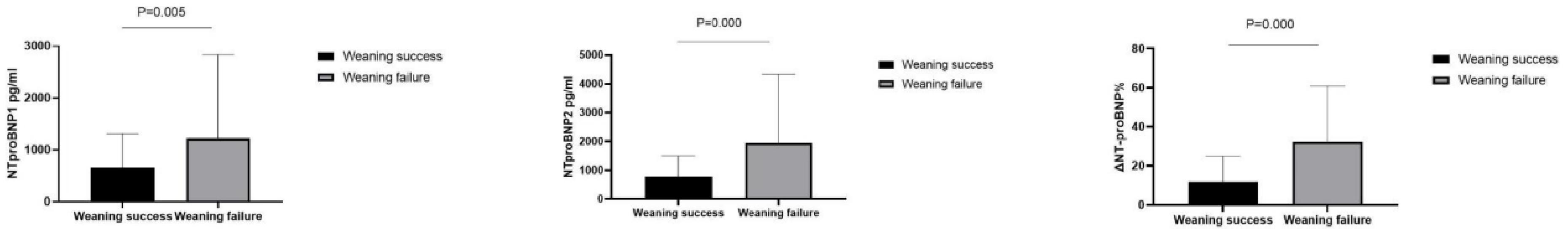


Fig. 2 The levels of NTproBNP1, NTproBNP2 and ΔNTproBNP% in the weaning success and failure group

Specific issue in trauma with Mechanical Ventilation

1. Timing of Mechanical Ventilation

Early Intubation

Archives of Academic Emergency Medicine. 2019; 7 (1): e35

OPEN ACCESS

ORIGINAL RESEARCH

Early Intubation vs. Supportive Care Outcomes in Patients with Severe Chest Trauma; a randomized trial study

Mohammad Nasr-Esfahani[1] , Amir Bahador Boroumand[2]* , Mohsen Kolahdouzan[3]

1. Department of Emergency Medicine, School of Medicine, Isfahan University of Medical Sciences, Isfahan, Iran.
2. Department of Emergency Medicine, School of Medicine, Isfahan University of Medical Sciences, Isfahan, Iran.
3. Department of surgery, Faculty of medicine, Isfahan university of medical sciences, Isfahan, Iran.

Table 1: Thoracic trauma severity score.[2]

Grade	PaO_2/FiO_2	Rib fracture	Lung contusions	Pleura	Age (yrs)	Point
0	>400	0	No	No	<30	0
1	300-400	01-Mar	Unilobar Unilateral	Pneumothorax	30-41	1
2	200-300	>3 unilateral	Unilobar bilateral or bilobar unilateral	Hemothorax or hemo-pneumothorax, unilateral	42-54	2
3	150-200	>3 bilateral	Bilateral <2 lobules	Hemothorax or hemo-pneumothorax bilateral	55-70	3
4	<150	Flail chest	Bilateral > 2 lobules	Tension pneumothorax	>70	5

Table 2: Outcomes of patients in early intubation and supportive care groups

Outcome	Early intubation	Control	P
Duration of hospitalization	5.18±1.33	9.43±2.25	0.01
Complete recovery	29 (90.6)	22 (68.8)	0.03
Recovery with complications	3 (9.4)	10 (31.3)	0.01

Data are presented as frequency (%).

Journal of Surgical Research **170**, 286–290 (2011)
doi:10.1016/j.jss.2011.03.044

ASSOCIATION FOR ACADEMIC SURGERY

Timing is Everything: Delayed Intubation is Associated with Increased Mortality in Initially Stable Trauma Patients[1]

Emily Miraflor, M.D., Kelly Chuang, M.D., Marvin A. Miranda, B.A., Wendy Dryden, B.A., Louise Yeung, M.D., Aaron Strumwasser, M.D., and Gregory P. Victorino, M.D.[2]

Department of Surgery, UCSF–East Bay, Alameda County Medical Center, Oakland, California

Submitted for publication January 7, 2011

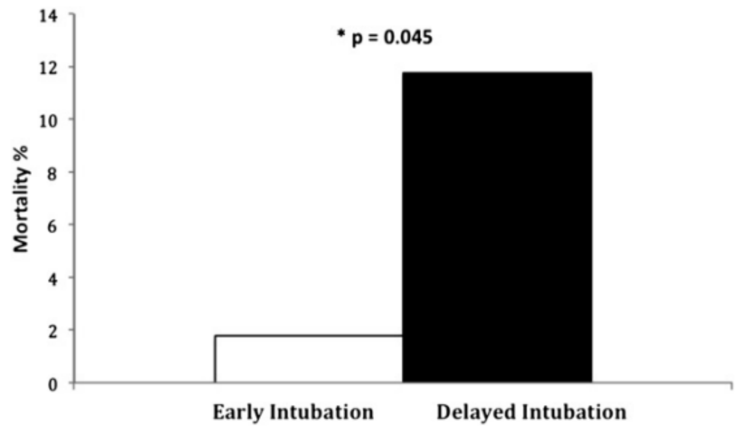
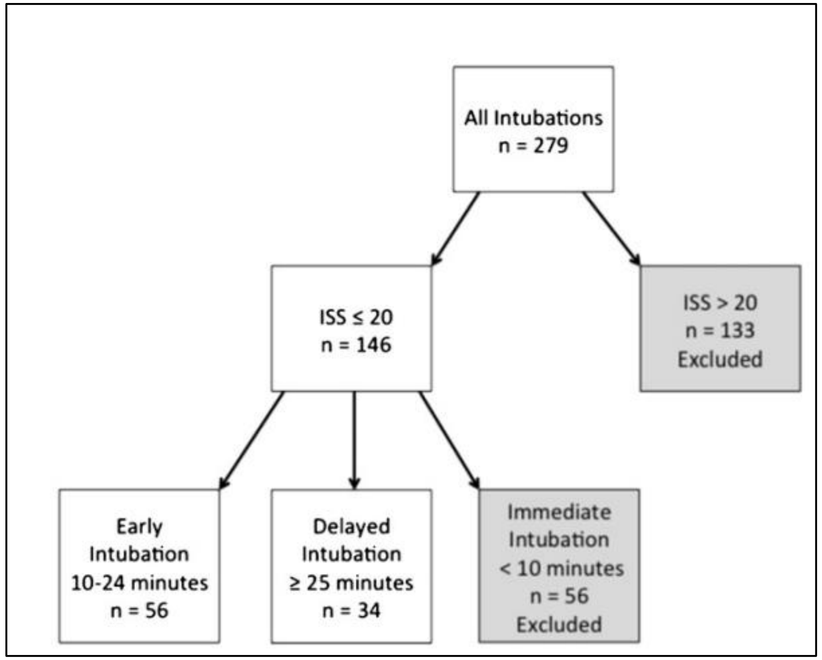


FIG. 2. Mortality in moderately injured patients by timing of intubation. Moderately injured patients (ISS $<$ 20) intubated late had a higher mortality, 11.8%, than those intubated early, 1.8% (P = 0.045). The mortality risk reduction with earlier intubation was 85%.



- Timing of intubation of initially stable, moderately injured trauma patients affects mortality
- Initially stable, moderately injured patients who later deteriorate and require delayed intubation had a higher mortality

2. Occult pneumothorax in Mechanical Ventilation

Clinical Study

Outcome of Concurrent Occult Hemothorax and Pneumothorax in Trauma Patients Who Required Assisted Ventilation

Ismail Mahmood,[1] Zainab Tawfeek,[2] Ayman El-Menyar,[3,4,5] Ahmad Zarour,[1] Ibrahim Afifi,[1] Suresh Kumar,[1] Ruben Peralta,[1] Rifat Latifi,[1] and Hassan Al-Thani[1]

[1] *Department of Surgery, Section of Trauma Surgery, Hamad General Hospital, P.O. Box 3050, Doha, Qatar*
[2] *Department of Emergency, Hamad Medical Corporation, P.O. Box 3050, Doha, Qatar*
[3] *Clinical Research, Section of Trauma Surgery, Hamad General Hospital, Doha, Qatar*
[4] *Clinical Medicine, Weill Cornell Medical School, P.O. Box 24144, Doha, Qatar*
[5] *Internal Medicine, Ahmed Maher Teaching Hospital, Cairo, Egypt*

- Occult HPTX can be carefully observed in patients with chest trauma who required positive pressure ventilation.
- Moreover, delayed tube thoracostomy is not associated with an adverse event
- With close observation

use of tube thoracotomy could be minimized and only restricted to those patients who had evidence of progression of hemo- or pneumothorax (increase in size) on follow up chest radiographs or developed respiratory compromise.

3. Pleural effusion in Mechanical Ventilation

Prevalence and Impact on Weaning of Pleural Effusion at the Time of Liberation from Mechanical Ventilation

A Multicenter Prospective Observational Study

Martin Dres, M.D., Damien Roux, M.D., Ph.D., Tài Pham, M.D., Alexandra Beurton, M.D.,
Jean-Damien Ricard, M.D., Ph.D., Muriel Fartoukh, M.D., Ph.D., Alexandre Demoule, M.D., Ph.D.

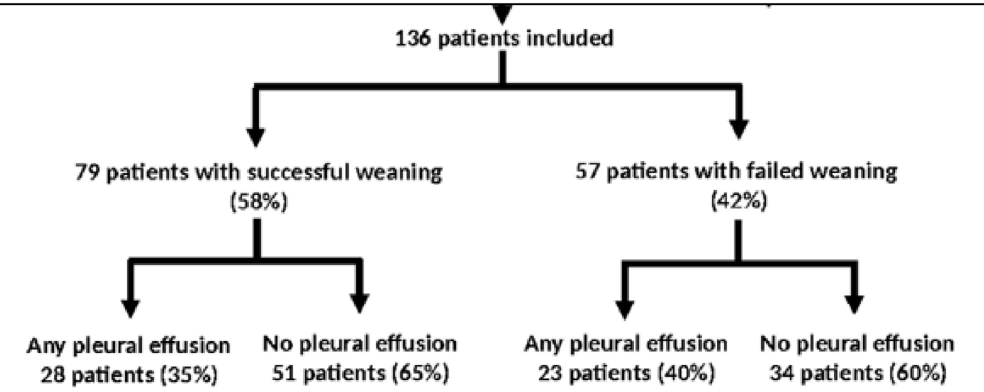


Fig. 2. Study flow chart. SBT = spontaneous breathing trial.

Fig. 1. Estimation of the volume of pleural fluid according to the classification of the British Thoracic Society.[17] The volume of fluid was estimated as small in (*A*), moderate in (*B*), and large in (*C*).

CRITICAL CARE MEDICINE

Prevalence and Impact on Weaning of Pleural Effusion at the Time of Liberation from Mechanical Ventilation

A Multicenter Prospective Observational Study

Martin Dres, M.D., Damien Roux, M.D., Ph.D., Tài Pham, M.D., Alexandra Beurton, M.D., Jean-Damien Ricard, M.D., Ph.D., Muriel Fartoukh, M.D., Ph.D., Alexandre Demoule, M.D., Ph.D.

- Significant pleural effusion is observed in approximately 13% of patients at the time of liberation from mechanical ventilation and is not associated with any significant impact on the results of weaning.
- Other mechanisms should be carefully excluded before attributing weaning failure to pleural effusion.

Razazi et al. Ann. Intensive Care (2018) 8:103
https://doi.org/10.1186/s13613-018-0446-y

Annals of Intensive Care

RESEARCH Open Access

Pleural effusion during weaning from mechanical ventilation: a prospective observational multicenter study

Keyvan Razazi[1,2,3*], Florence Boissier[4,5], Mathilde Neuville[6], Sébastien Jochmans[2,7], Martial Tchir[8], Faten May[1,2], Nicolas de Prost[1,2], Christian Brun-Buisson[1,2], Guillaume Carteaux[1,2] and Armand Mekontso Dessap[1,2,3]

Table 4 Univariate and multivariable logistic regression of factors associated with weaning failure (n = 246)

Variables	Missing values, n (%)	Absolute standardized differences	Odd ratio (95% confidence interval), *p* value by logistic regression: Univariate	Odd ratio (95% confidence interval), *p* value by logistic regression: Multivariable
Age (per year)	0	47	1.03 (1.01–1.05), $p = 0.01$	1.02 (0.997–1.05), $p = 0.08$
Body mass index (per kg/m^2)	6 (2%)	32	1.06 (1.01–1.11), $p = 0.02$	I/NR
COPD (yes vs. no)	0	48	3.0 (1.6–5.8), $p = 0.001$	2.2 (1.02–4.7), $p = 0.045$
Cardiac disease (yes vs. no)	0	37	2.2 (1.2–4.0), $p = 0.01$	I/NR
Left ventricle ejection fraction at cardiac ultrasound (%)	44 (18%)	27	0.98 (0.96–1.0), $p = 0.09$	NI
Supra-ventricular arrhythmias (yes vs. no)	0	26	1.9 (1.01–3.6), $p = 0.046$	NI
Septic shock (yes vs. no)	0	37	2.1 (1.2–3.7), $p = 0.01$	I/NR
Fluid balance between ICU admission and first SBT (per L)	15 (6%)	44	1.07 (1.03–1.12), $p = 0.002$	NI
Acute respiratory failure as cause of intubation (yes vs. no)	0	55	3.0 (1.7–5.2), $p < 0.001$	NI
PaO_2/FiO_2 ratio (per mmHg)	3 (1%)	58	0.994 (0.991–0.997), $p < 0.001$	0.996 (0.993–1.0), $p = 0.03$
Duration of MV before the first SBT (per day)	0	57	1.11 (1.06–1.17), $p < 0.001$	1.11 (1.05–1.17), $p < 0.001$
ARDS before the first SBT (yes vs. no)	0	49	3.0 (1.6–5.7), $p < 0.001$	NI
Neuromuscular blockade before the first SBT (yes vs. no)	0	54	3.5 (1.9–6.6), $p < 0.001$	NI
VAP before the first SBT (yes vs. no)	0	33	2.6 (1.2–5.4), $p = 0.01$	NI
Moderate-to-large pleural effusion (yes vs. no)	0	58	3.2 (1.8–5.7), $p < 0.001$	3.0 (1.5–5.8), $p = 0.001$

- Moderate-to-large pleural effusion was found in one third of patients at initiation of weaning and associated with worse outcomes.

3. Screening bronchoscopy strategy in Mechanical Ventilation

Review > Am Surg. 2022 Apr;88(4):653-657. doi: 10.1177/00031348211058639. Epub 2021 Dec 8.

Bronchoscopy Decreases Ventilator-Associated Pneumonia in Trauma Patients

Siddhartha Nannapaneni [1], Jennifer Silvis [2], Karleigh Curfman [1], Timothy Chung [1], Thomas Simunich [3], Shawna Morrissey [1], Russell Dumire [3]

- 13% lower VAP rate in the bronchoscopy group (*YB*) as compared to the group that did not receive bronchoscopy (NB) ($P < .025$

AAST PODIUM PAPER 2022

Early pneumonia diagnosis decreases ventilator-associated pneumonia rates in trauma population

Kevin N. Harrell, MD, William B. Lee, MD, Hunter J. Rooks, MD, W. Eric Briscoe, MD, Walter Capote, MD, Benjamin W. Dart, IV, MD, Darren J. Hunt, MD, *and* **Robert A. Maxwell, MD**, *Chattanooga, Tennessee*

- Early FOB and BAL allow the identification of EP in patients at high risk for aspiration and VAP and allow for prompt treatment of early respiratory tract infection

4. Flail chest in Mechanical Ventilation

European Journal of Cardio-Thoracic Surgery 51 (2017) 696–701
doi:10.1093/ejcts/ezw365 Advance Access publication 14 December 2016

ORIGINAL ARTICLE

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Chest wall stabilization in ventilator-dependent traumatic flail chest patients: who benefits?†

Gregor J. Kocher, Siamak Sharafi, Luis Filipe Azenha and Ralph A. Schmid*

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- selected patients suffering from traumatic flail chest may profit from early rib fixation if chest wall instability is the main reason for ventilator-dependency

European Journal of Trauma and Emergency Surgery (2023) 49:1047–1055
https://doi.org/10.1007/s00068-022-02152-1

ORIGINAL ARTICLE

Check for updates

Flail chest injury—changing management and outcomes

Silvana F. Marasco[1,2] · Jacqueline Nguyen Khuong[1] · Mark Fitzgerald[2,3,4] · Robyn Summerhayes[1] · Mir Wais Sekandarzad[5] · Vincent Varley[2] · Ryan J. Campbell[2] · Michael Bailey[6]

Received: 6 March 2022 / Accepted: 21 October 2022 / Published online: 1 November 2022

Table 4 Annual change in outcomes

Outcome	Univariable		Multivariable*	
	Odds ratio (95% CI)	*P* value	Odds ratio (95% CI)	*P* value
Admission to ICU	0.98 (0.94–1.03)	0.45	1.01 (0.96–1.06)	0.76
ARDS	1.10 (0.90–1.33)	0.35	1.10 (0.88–1.37)	0.40
Hospital mortality	1.04 (0.97–1.13)	0.26	1.05 (0.97–1.15)	0.24
Discharge home	1.02 (0.97–1.06)	0.50	1.01 (0.96–1.06)	0.74
Discharge other	1.01 (0.93–1.09)	0.88	0.97 (0.89–1.06)	0.49
Discharge rehabilitation	0.97 (0.93–1.01)	0.16	0.97 (0.92–1.02)	0.20
Pneumonia	0.95 (0.91–1.00)	0.07	0.96 (0.91–1.02)	0.17
Sepsis	0.99 (0.92–1.07)	0.84	1.00 (0.92–1.09)	0.99
	Annual % change (95% CI)		Annual % change (95% CI)	
ICU length of stay	– 0.07 (– 0.10 to – 0.05)	< 0.0001	– 0.06 (– 0.08 to – 0.03)	< 0.0001*
Duration of ventilation	– 0.03 (– 0.06 to 0.01)	0.15	– 0.04 (– 0.08 to – 0.01)	0.02*
Hospital length of stay	– 0.02 (– 0.05 to 0)	0.07	– 0.02 (– 0.04 to 0.01)	0.20

ARDS adult respiratory distress syndrome, *ICU* intensive care unit

Medical Management in Mechanical Ventilation

Review

Prolonged Mechanical Ventilation: Outcomes and Management

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Table 2

Management of prolonged mechanical ventilation.

Systemic comorbidities treatment
Infection treatment
Nutrition support
Physical exercise programs
Breathing control
Passive leg raising
Weighted resistance
Stationary cycle ergometry training
Respiratory muscle training
Active limb exercise
Physiotherapy with positive pressure
Additional pressure support during exercise
Intermittent positive pressure breathing during exercise
Cough augmentation techniques
Electrical muscle stimulation therapy

Take Home Message

- Mechanical ventilation is essential for patients with indications.
- Mechanical ventilation can sometimes be harmful to patients.
- There is no single golden rule.
- Continuous monitoring and appropriate application to the situation can yield good results.
- In prolonged mechanical ventilation, various factors should be considered

경청해 주셔서 감사합니다!