

Engstrom studies



GE imagination at work

Engstrom studies

INview: the essential



GE imagination at work

Title of article:

Estimation of Functional Residual Capacity at the Bedside Using Standard Monitoring Equipment: A Modified Nitrogen Washout/Washin Technique Requiring a Small Change of the Inspired Oxygen Fraction

Authors: Cecilia Olegård, MD*, Soren Sondergaard, MD, PhD*, Erik Houltz, MD, PhD†, Stefan Lundin, MD, PhD*, and Ola Stenqvist, MD, PhD*

**Department of Anesthesiology and Intensive Care and †Department of Thoracic Anesthesiology, Sahlgrenska University Hospital, Gothenburg, Sweden*

Presentation: Anesth Analg 2005;101:206–12

Aim of the study: Developed a modified nitrogen washin/washout technique based on standard monitors using inspiratory and end-tidal gas concentration values for functional residual capacity (FRC) measurements in patients with acute respiratory failure (ARF)

Conclusion: This study shows good precision of FRC measurements with standard monitors using a change in F_{iO_2} of only 0.1. Measurements can be performed with equal precision up to an F_{iO_2} of 1.0.



GE imagination at work

Title of article:

Practical assessment of respiratory mechanics

Authors: Ola Stenqvist, MD, PhD*

**Department of Anesthesiology and Intensive Care, Sahlgrenska University Hospital, Gothenburg, Sweden*

Presentation: British Journal of Anaesthesia 91 (1): 92±105 (2003)

Aim of the study: Assessment lung mechanic measurements during mechanical ventilation in the clinical practice (overview of P-V curve methods)

Conclusion: Clinical study measurement methods are often crude and inadequate for the ventilatory strategy chosen in the study. Rather than static and semistatic methods for P±V loops, dynamic P±V loops using the SLICE method or the dynostatic algorithm will show immediately if a lower inflection point is present, and indicate clearly any tendency to overstretch the lungs



GE imagination at work

Title of article:

Direct tracheal airway pressure measurements are essential for safe and accurate dynamic monitoring of respiratory mechanics. A laboratory study

Authors: S. Kà Rasoni, S. Sondergaard¹, S. Lundini¹, J. Wiklund² and O. Stenqvist¹

Departments of ¹Anaesthesia and Intensive Care and ²Biomedical Engineering, Sahlgrenska University Hospital, Göteborg, Sweden

Presentation: Acta Anaesthesiol Scand 2001; **45**: 173–179

Aim of the study: The aim of this study was to investigate factors that may vary ETT-Res, causing difficulties in ETT-Res estimation clinically, and to evaluate a method for direct Trach-P measurements to obviate these problems.

Conclusion: ETT connections and secretions cause a variance in resistance. Tracheal pressure can be measured with high precision with an air- or liquid-filled catheter. An end hole catheter placed within 2 cm above or below the ETT tip will give sufficiently precise measurements for clinical purposes.



GE imagination at work

Title of article:

Continuous on-line measurement of respiratory system, lung and chest wall mechanics during mechanical ventilation

Authors: S. Karason, S. Sondergaard¹, S. Lundini¹, J. and O. Stenqvist¹

Departments of ¹Anaesthesia and Intensive Care and ²Biomedical Engineering, Sahlgrenska University Hospital, Göteborg, Sweden

Presentation: Intensive Care Medicine (2001); **27:** 1328–1339

Aim of the study: A concept of on-line, manoeuvre-free monitoring of respiratory mechanics during dynamic conditions (dynostatic curve), displaying calculated alveolar pressure/volume curves continuously and separating lung and chest wall mechanics.

Conclusion: The monitoring concept revealed a constant pattern of successively decreasing compliance within each breath, which became more prominent with increasing PEEP and tidal volume. The monitoring concept offers a simple and reliable method of monitoring respiratory mechanics during ongoing ventilator treatment.



GE imagination at work

Title of article:

Alveolar pressure monitoring: an evaluation in a lung model and in patients with acute lung injury

Authors: S. Karason, S. Sondergaard¹, S. Wikund¹, J. and O. Stenqvist¹

Departments of ¹Anaesthesia and Intensive Care and ²Biomedical Engineering, Sahlgrenska University Hospital, Göteborg, Sweden

Presentation: Intensive Care Medicine (2003); **29**: 955–962

Aim of the study: Evaluation of an algorithm for continuous on-line monitoring of alveolar pressure over time in a lung model with lower and upper inflection points and variable resistance ratios and in patients with acute lung injury. The algorithm is based on "static" pressure/volume curves obtained from tracheal pressure measurements under dynamic conditions.

Conclusion: Using a thin tracheal pressure catheter inserted through the endotracheal tube alveolar pressure allows continuous bedside monitoring with ease and precision using the dynostatic algorithm. The method is unaffected by tube and connector geometry or by secretions.



GE imagination at work

Engstrom studies

Benchmarking & validation



GE imagination at work

Title of abstract:

Measurement of EELV: comparison between nitrogen washin/washout and CT scan quantitative analysis

Authors: Chierichetti M, Chiumello D, Tallarini F, Botticelli M, Carsenzola C, Azzari S, Motta G, Berto V, Rosti V, Gattinoni L - *IRCSS foundation-Ospedale Maggiore Policlinico, Mangiagalli, Regina Elena of Milan, Department of anaesthesia and intensive care, University of study of Milan*

Presentation: ISICEM 2008

Aim of the study: Comparing the N₂ washin/washout technique implemented in the Engstrom Carestation (EELVEC) to CT scan quantitative analysis of lung tissues (EELVTC).

Conclusion: The absolute difference between EELVEC and EELVTC is 14,3%. Based on literature results, the accuracy of this technique can be considered satisfactory.



GE imagination at work

Title of abstract:

Performance of ICU ventilators during pressure support ventilation mode: a bench study

Authors: Aissam Lyazidi, Fabrice Galia, Arnaud Thille, Fabiano Di Marco, Laurent Brochard.
Service de Réanimation Médicale. AP-HP, CHU Henri Mondor. INSERM U 651, Université Paris 12, Créteil, France.

Presentation : ISICEM 2007

Aim of the study: The purpose of this study was to evaluate, on a bench test, the overall performance observed during PSV among thirteen modern commercially available ICU ventilators: successively tested under the simulated breathing conditions.

1) Trigger Phase

- The time delay (**TD**) between the onset of the effort and the time at which the airway pressure signal rose.
- The maximal decrease in Paw (**Delta Paw**) measured from baseline value.

2) pressurization

- The pressurization is evaluated by the area measured at 0.3s (**Area0.3**) .

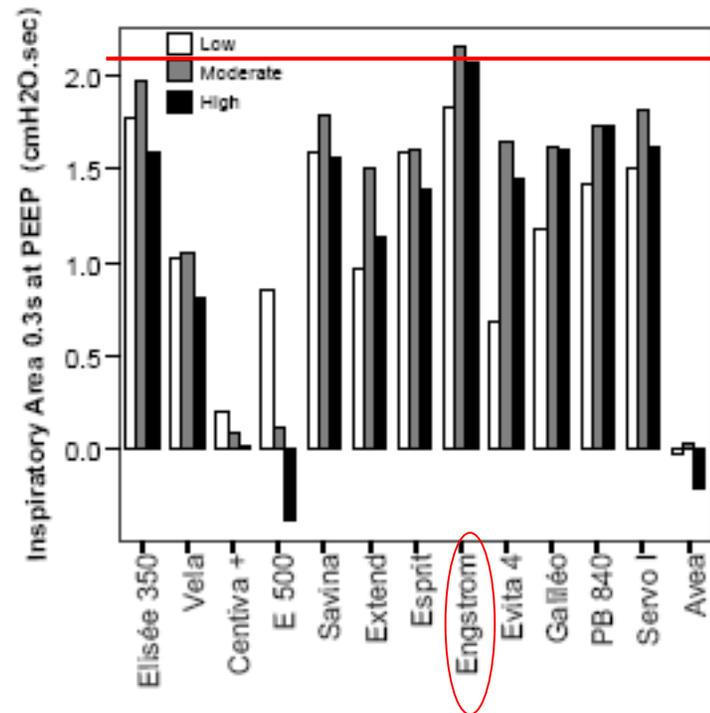
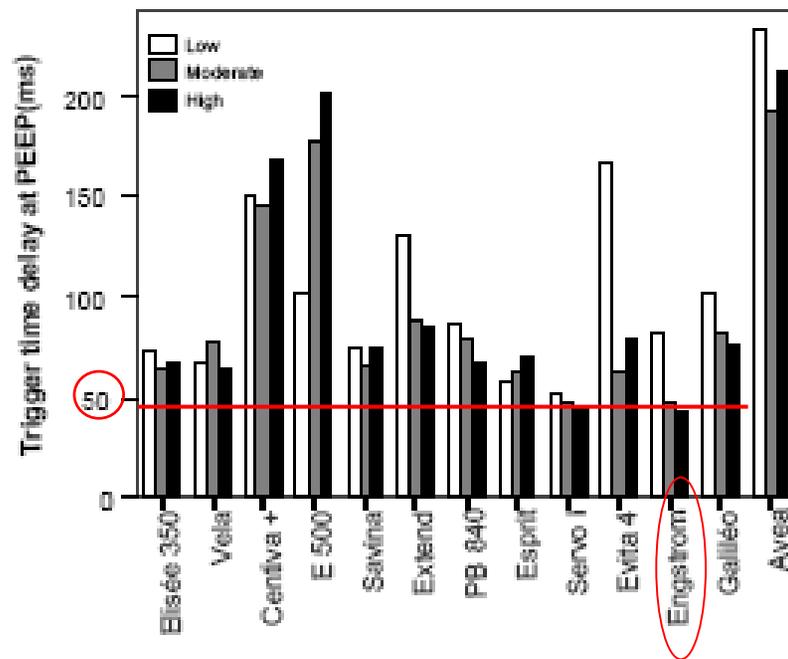


GE imagination at work

Title of abstract:

Performance of ICU ventilators during pressure support ventilation mode: a bench study

Conclusion:



GE imagination at work

Title of abstract:

How ICU ventilators compensate for compressed gas volume a bench test

Authors: A. Lyazidi¹, J. C. Richard², A. W. Thille¹, O. Besson³, L. Brochard¹, ¹ *Service de réanimation médicale, Hôpital Henri Mondor, Université Paris XII, Inserm U841, Créteil, France.* ²*Service de réanimation médicale, CHU Charles Nicole, UPRES EA3830, Rouen, France.* ³*AGEPS, AP-HP, Paris, France*

Presentation: ESICM 2007

Aim of the study: We evaluated on a passive bench model (Michigan test lung), five ICU ventilators which compensate compressed Tidal volume VT compared with a ventilator without compensation



GE imagination at work

Title of abstract:

How ICU ventilators compensate for compressed gas volume a bench test

Conclusion:

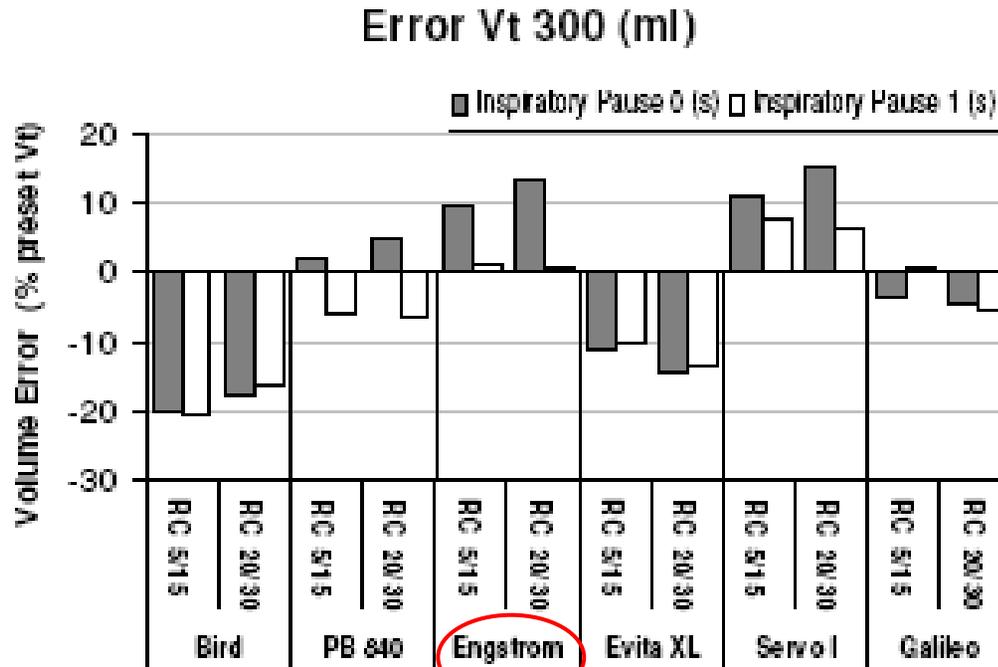


Fig 4: Volume error (% preset volume 300ml) for each ventilator.



GE imagination at work

Engstrom's studies

FRC



GE imagination at work

Title of abstract:

A novel system to evaluation of pulmonary Functional Residual Capacity in Intensive Care Unit: preliminary data

Authors: Tiziana Principi, Gabriele Falzetti, Paolo Pelaia - Anaesthesia and Intensive Care Clinic (Dir.: Prof. P. Pelaia) – *Politechnical University of Marche – Ancona – Italy*

Presentation: ISICEM 2007

Aim of the study: Aim of this study is to evaluate efficacy of pulmonary recruitment by use of Functional Residual Capacity (FRC) measurement with Engstrom Carestation FRC INview™ system (GE HealthCare – 2006), in patients with high pulmonary recruitment range and in patients with low recruitment range.

Conclusion: On limit of low sample size, these preliminary data suggest that Engstrom Carestation FRC evaluation system is a good parameter to optimized pulmonary recruitment and seems to be in a position to overcame Cstat limit for the evaluation of pulmonary recruitable parenchyma.



GE imagination at work

Title of abstract:

FRC measurements during mechanical ventilation in ICU patients

Authors: IG Bikker; J Van Bommel; D Dos Reis Miranda; D Gommers
Erasmus medical center, intensive care, Rotterdam, Netherlands

Presentation: ISICEM 2008

Aim of the study: The aim of this study was to measure EELV levels at three different PEEP levels in ventilated patients with different diseases. One of the mechanisms of application of optimal PEEP could be measurement of FRC or end expiratory lung volume (EELV) in mechanically ventilated patients.

Conclusion: The conclusion is that EELV values decreased significantly after stepwise reduction of the PEEP levels from 15 to 5 cm H₂O, whereas PaO₂/FiO₂ ratio did not change. This indicates that monitoring patient's lung function could be a prerequisite to find the optimal PEEP in order to prevent VILI.



GE imagination at work

Title of abstract:

Open lung ventilation in cardiac surgery patients

Authors: IG Bikker; J Van Bommel; D Dos Reis Miranda; D Gommers
Erasmus medical center, intensive care, Rotterdam, Netherlands

Presentation: Abu Dhabi 2008

Aim of the study: The open lung concept (OLC) is also a protective ventilation strategy that combines low tidal volume ventilation with high levels of PEEP. To open up collapsed alveoli, a recruitment maneuver is performed and a sufficient level of positive end-expiratory pressure (PEEP) is used to keep the lung open. The smallest possible pressure amplitude is used in order to prevent lung overdistention and this results in a low tidal volume (4-6 ml/kg) ventilation. .

Conclusion: The open lung concept is a lung protective ventilation strategy, reducing pulmonary dysfunction after cardiac surgery. In addition, new bedside techniques (FRC, EIT) have been introduced to monitor the patient's lung function that could be of special importance during the application of the open lung concept.



GE imagination at work

Title of abstract:

Effect of vertical positioning on lung volume and oxygenation

Authors: J Dellamonica^{1,2}, N Lerolle³, C Sargentini⁴, A. Thille¹, G Beduneau⁵, A Mercat⁴, JC Richard⁵, F Di Marco^{1,6}, L Brochard¹

MICU ¹Hôpital Henri Mondor & INSERM U841 Créteil, ²CHU de Nice, ³HEGP Paris, ⁴CHU Angers, ⁵CHU Rouen, France ⁶Ospedale San Paolo, Milan Italy

Presentation: ATS - Toronto 2008

Aim of the study: Looking for a relationship between change in lung volume (EELV) and oxygenation during successive trunk position epochs (Supine, Semi recumbent: trunk elevated at 30°, Seated: trunk elevated at 45° and legs down at 45° “Hill-Rom Totalcare beds”, and back to Supine).

Conclusion: Vertical position increases PaO₂ /FiO₂ ratio (more than 20%) and EELV in approximately one third of patients with ARDS. An association between lung volume and oxygenation increase seemed to explain the difference between responders and non responders. Seated position was more efficient than semi-recumbent.



GE imagination at work

Title of abstract:

Functional residual capacity measurement as a guide during Peep titration in ARDS

Authors: B.Lambermont, A.Ghuysen, V.Mommens, N.Janssen, P.Kolh, P.Morimont, C.Garweg, B.Ghaye, V.D'Orio
University Hospital of Liege, Belgium

Presentation: ESICM 2007 – SRLF 2008

Aim of the study: Testing a new method of FRC measurement (Engstrom Carestation, General Electric) in an experimental model of ARDS in order to assess the changes in FRC in response to Peep settings and evaluate the effects on pulmonary gas exchanges.

Conclusion: As suggested by our results, such an assessment is a valuable tool to help to identify the optimal level of PEEP. It can also be used for trend analysis: a decrease in FRC can be the first sign of derecruitment and may help the clinician to understand the pathophysiological mechanism worsening blood oxygenation; finally this parameter might provide practical help in therapeutic decision making.



GE imagination at work

Title of abstract:

Closed system endotracheal suction to reduce loss on Functional Residual Capacity (FRC) during pressure-controlled mechanical ventilation.

Authors: G Falzetti; T Principi; S Marzocchini; G Narcisi; M Caimmi; P Pelaia
Politechnical University of Marche, Neurosciences Department/Anesthesia and Intensive Care Service, Ancona, Italy

Presentation: ISICEM 2008

Aim of the study: Aim of study is the evaluation of efficacy to limit loss on FRC of Endotracheal Suction (ES) with Closed System (ESCS) vs ES with Open standard system (ESOS) in patients (pz) needing ventilation with PEEP > 10 cm H₂O

Conclusion: ESCS in patients needing mechanical ventilation with PEEP > 10 cm H₂O for ARF reduces significantly the loss on FRC, the reduction on PaO₂ and time to recovery of loss after suction greater than standard open suction. In this way could be possible to avoid pulmonary overdistension made by recruitment manoeuvres, often necessary after suction with open system to recovery the loss on FRC and PaO₂



GE imagination at work