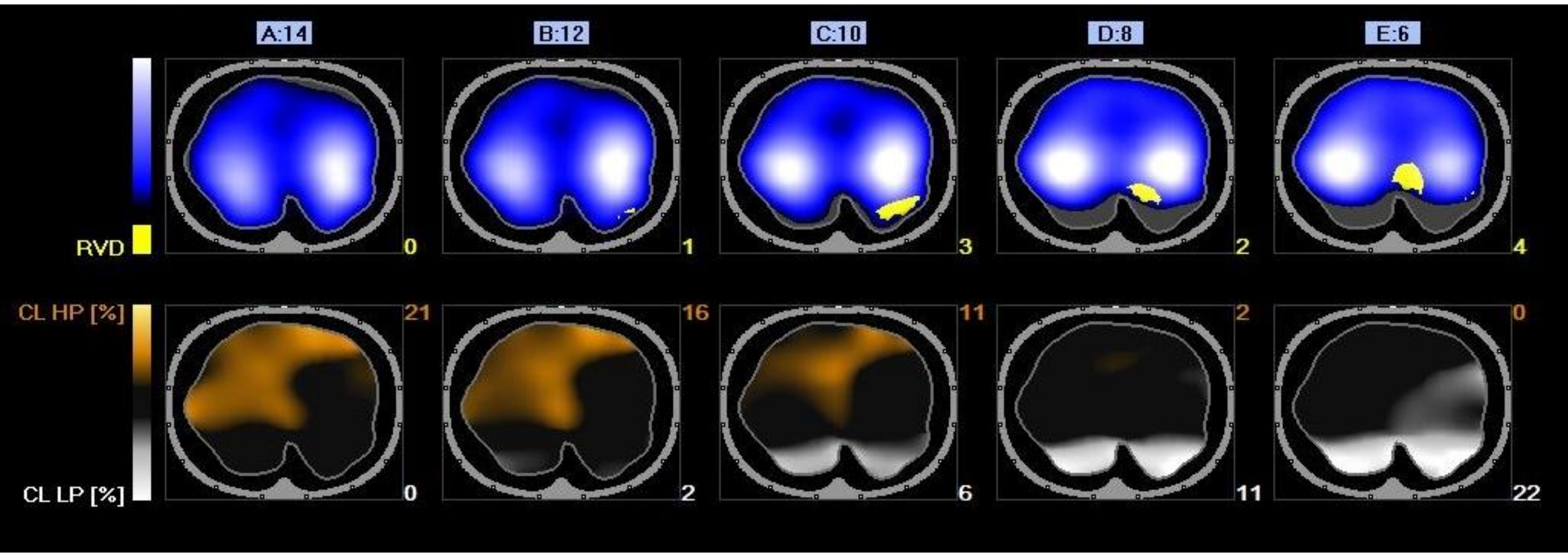

Literature List
Electrical Impedance Tomography

2018

Electrical Impedance Tomography (EIT)
Literature List 2018

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Categories

CLIN = Clinical Study

ES = Experimental Study

REV = Review

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Electrical Impedance Tomography (EIT)
Literature List 2018

CR	**Akhavan S, et al.**	**The role of electrical impedance tomography for monitoring during bronchoscopy: A case report**	*Journ of Crit Care Vol 48* ***2018 Dec***

Abstract: Continuous monitoring of lung ventilation can be useful in treating patients admitted to the intensive care unit (ICU). Electrical impedance tomography (EIT) has been used as a relatively new imaging technique for this purpose. We presented a patient with pneumonia who was admitted to the ICU after pulmonary thromboembolism (PTE) required to perform bronchoalveolar lavage (BAL). A drainage procedure and subsequent improvement in pulmonary function were monitored using EIT contributed to the treatment process. The patient has been discharged from the hospital with an improved general condition.

CLIN	**Eichler L, et al.**	**Lung aeration and ventilation after percutaneous tracheotomy measured by electrical impedance tomography in non-hypoxemic critically ill patients: a prospective observational study.**	*Annals of Intensive Care* ***2018 Nov***

Background: Percutaneous dilatational tracheotomy (PDT) may lead to transient impairment of pulmonary function due to suboptimal ventilation, loss of positive end-expiratory pressure (PEEP) and repetitive suction maneuvers during the procedure. Possible changes in regional lung aeration were investigated using electrical impedance tomography (EIT), an increasingly implied instrument for bedside monitoring of pulmonary aeration.

Methods: With local ethics committee approval, after obtaining written informed consent 29 patients scheduled for elective PDT under bronchoscopic control were studied during mechanical ventilation in supine position. Anesthetized patients were monitored with a 16-electrode EIT monitor for 2 min at four time points: (a) before and (b) after initiation of neuromuscular blockade (NMB), (c) after dilatational tracheostomy (PDT) and (d) after a standardized recruitment maneuver (RM) following surgery, respectively. Possible changes in lung aeration were detected by changes in end-expiratory lung impedance (Δ EELI). Global and regional ventilation was characterized by analysis of tidal impedance variation.

Results: While NMB had no detectable effect on EELI, PDT led to significantly reduced EELI in dorsal lung regions as compared to baseline, suggesting reduced regional aeration. This effect could be reversed by a standardized RM. Mean delta EELI from baseline (SE) was: NMB − 47 ± 62; PDT − 490 ± 180; RM − 89 ± 176, values shown as arbitrary units (a.u.). Analysis of regional tidal impedance variation, a robust measure of regional ventilation, did not show significant changes in ventilation distribution.

Conclusion: Though changes of EELI might suggest temporary loss of aeration in dorsal lung regions, PDT does not lead to significant changes in either regional ventilation distribution or oxygenation.

CR	**Tingay DG, et al.**	**Electrical Impedance Tomography can identify ventilation and perfusion defects: A neonatal case**	*Am J Respir Crit Care Med.* ***2018 Oct***

Conclusions: This case report describes the first report of EIT to measure perfusion and ventilation patterns in a newborn with a known loss of both in a single lung. EIT was able to demonstrate the perfusion and ventilation defects found on static radiological imaging. Importantly EIT recordings within the heart-rate domain were independent of heart movement and at a respiratory resolution able to identify small areas of tidal ventilation. This suggests that EIT may hold promise as the first tool able to dynamically measure ventilation-perfusion matching over time in infants.

REV	**Bachmann M C, et al.**	**Electrical impedance tomography in acute respiratory distress syndrome**	*Critical Care* ***2018 Oct***

Abstract: Acute respiratory distress syndrome (ARDS) is a clinical entity that acutely affects the lung parenchyma, and is characterized by diffuse alveolar damage and increased pulmonary vascular permeability. Currently, computed tomography (CT) is commonly used for classifying and prognosticating ARDS. However, performing this examination in critically ill patients is complex, due to the need to transfer these patients to the CT room. Fortunately, new technologies have been developed that allow the monitoring of patients at the bedside. Electrical impedance tomography (EIT) is a monitoring tool that allows one to evaluate at the bedside the distribution of pulmonary ventilation continuously, in real time, and which has proven to be useful in optimizing mechanical ventilation parameters in critically ill patients. Several clinical applications of EIT have been developed during the last years and the technique has been generating increasing interest among researchers. However, among clinicians, there is still a lack of knowledge regarding the technical principles of EIT and potential applications in ARDS patients. The aim of this review is to present the characteristics, technical concepts, and clinical applications of EIT, which may allow better monitoring of lung function during ARDS.

REV	**Mauri T, et al.**	**What’s new in electrical impedance tomography**	*Intensive Care Med* ***2018 Oct***

Introduction: Electrical impedance tomography (EIT) is a dynamic, non-invasive, radiation-free, bedside lung imaging technique. Based on the application of alternate microcurrents spinning at 20–50 Hz along a set of electrodes (16 or 32, depending on the system) positioned around the patient’s thorax, EIT allows continuous tomographic mapping of the changes in regional gas content inside the chest. This technique provides several relevant physiologic measures, including regional tidal volume, heterogeneity of ventilation distribution, gravitational distribution of respiratory system compliance, as well as pulmonary perfusion, cardiac output, and central intravascular volume status. We present here the most recent advances at the crossroad between physiologic understanding and clinical applications.

CLIN	**Chaves JN, Jardim-Neto A.**	**Influence of positive end-expiratory pressure on regional ventilation assessed by Electrical Impedance Tomography on healthy lungs**	*BTSym'18* ***2018 Oct***

Abstract: Electrical impedance tomography is a promising tool to evaluate lung function of mechanically ventilated patients at bedside. The aim of this study was to assess the relationship between regional ventilation and positive end-expiratory pressure (PEEP) on healthy subjects undergoing laparoscopy surgery. On a PEEP titration maneuver, regional ventilation of 14 patients was analyzed at each PEEP step, during a low flow maneuver, comparing four lung areas equally segmented: left and right halves of dependent and non-dependent regions. The ventilatory participation of non-dependent region decreased during PEEP decrement while dependent regions increased its participation, presenting difference only on PEEP lower than 12 cmH_2O ($p < 0.001$). Except at 14cmH_2O PEEP step, there were no significant differences between ventilation on left and right quadrants. In conclusion, the results suggest that PEEP significantly influences regional ventilation on healthy lungs under mechanical ventilation.

REV	Santini A, et al.	**Thoracic electrical impedance tomography: an adaptive monitor for dynamic organs**	*JECCM* **2018 Sep**

Abstract: Electrical impedance tomography (EIT) is increasingly used in intensive care patients to monitor pulmonary and cardiac function non-invasively at the bedside. Impedance variations measured by EIT due to a change in thoracic air content represent the largest and most studied signal, allowing the measurement of end-expiratory lung volume (EELV), global and regional ventilation and spatial and temporal heterogeneity of ventilation distribution. This technique gives a dynamic, repeatable, global and regional description of the respiratory system mechanics, providing at the same time a dynamic picture of lung function. A smaller but detectable change in electrical impedance is due to the increase/decrease of blood content into lung vascular tree during the cardiac cycle. This signal is used to measure stroke volume and global and regional lung perfusion. The integration of the ventilation and perfusion components of the EIT signal can be used to measure ventilation-perfusion matching. The aim of this review is to describe the current clinical applications of EIT, providing a guide to the most relevant physiologic variables derived from EIT and their clinical meaning. We will focus on respiratory and cardiac-related variables and their application in both the anesthetized and awake patients. A special attention will be given to two greatly expanding fields of use: pediatric patients and the perioperative (adult and pediatric) setting. Finally, we will describe potential future applications which we expect will soon become a reality, with the potential to change our everyday practice in the intensive care unit and the operating theatre.

CR	Hempel G, et al.	**Electrical Impedance Tomography for Confirmation of Lung Isolation during One-lung Ventilation**	*Anesthesiology Vol.129* **2018 Sep**

Introduction: One-lung ventilation is regularly performed to facilitate thoracic surgical procedures during general anesthesia. The adequacy of one-lung ventilation following placement of a double-lumen endotracheal tube was verified by auscultation and intermittent fiberoptic bronchoscopy. In addition, we continuously monitored one-lung ventilation by electrical impedance tomography, which is a noninvasive, radiation-free bedside method that continuously displays regional distribution of ventilation and may help to optimize ventilation during general anesthesia. Electrical impedance tomography measurements require a belt with electrodes around the patient’s chest. In brief, axial images are reconstructed from impedance changes induced by very small alternating electrical currents, that are applied through pairs of electrodes.

CLIN	Karagiannidis C, et al.	**Regional expiratory time constants in severe respiratory failure estimated by electrical impedance tomography: a feasibility study**	*Critical Care* ***2018 Sep***

Background: Electrical impedance tomography (EIT) has been used to guide mechanical ventilation in ICU patients with lung collapse. Its use in patients with obstructive pulmonary diseases has been rare since obstructions could not be monitored on a regional level at the bedside. The current study therefore determines breath-by-breath regional expiratory time constants in intubated patients with chronic obstructive pulmonary disease (COPD) and acute respiratory distress syndrome (ARDS).

Methods: Expiratory time constants calculated from the global impedance EIT signal were compared to the pneumatic volume signals measured with an electronic pneumotachograph. EIT-derived expiratory time constants were additionally determined on a regional and pixelwise level. However, regional EIT signals on a single pixel level could in principle not be compared with similar pneumatic changes since these measurements cannot be obtained in patients. For this study, EIT measurements were conducted in 14 intubated patients (mean Simplified Acute Physiology Score II (SAPS II) 35 ± 10, mean time on invasive mechanical ventilation 36 ± 26 days) under four different positive end-expiratory pressure (PEEP) levels ranging from 10 to 17 cmH_2O. Only patients with moderate-severe ARDS or COPD exacerbation were included into the study, preferentially within the first days following intubation.

Results: Spearman's correlation coefficient for comparison between EIT-derived time constants and those from flow/ volume curves was between 0.78 for tau (τ) calculated from the global impedance signal up to 0.83 for the mean of all pixelwise calculated regional impedance changes over the entire PEEP range. Furthermore, Bland-Altman analysis revealed a corresponding bias of 0.02 and 0.14 s within the limits of agreement ranging from − 0.50 to 0.65 s for the aforementioned calculation methods. In addition, exemplarily in patients with moderate-severe ARDS or COPD exacerbation, different PEEP levels were shown to have an influence on the distribution pattern of regional time constants.

Conclusions: EIT-based determination of breath-by-breath regional expiratory time constants is technically feasible, reliable and valid in invasively ventilated patients with severe respiratory failure and provides a promising tool to individually adjust mechanical ventilation in response to the patterns of regional airflow obstruction.

CR	Davies P, et al.	**Electrical impedance tomography effectively used in a case of paediatric pulmonary Langerhans cell histiocytosis.**	*BMJ Case Report* ***2018 Sep***

Abstract: A 2-year-old boy with severe pulmonary Langerhans cell histiocytosis presented in extreme respiratory failure. He was intubated and ventilated. Despite maximal support, he deteriorated and needed extremely high ventilator pressures. An electrical impedance tomography monitor was used to inform management. This is a monitoring technique which is not used in children due to the lack of suitable interface devices and a lack of randomised clinical evidence. Despite technical difficulties, a good signal was achieved. This informed management and enabled the selection of a suitable ventilator strategy, facilitating weaning. Electrical impedance tomography is a viable technology for use in paediatric critical respiratory failure. This is a non-invasive and safe technology which adds individual patient information which is not available through any other modalities. We urge equipment manufacturers to develop belts which will allow routine application of this life-saving technology in children.

CR	Droghi MT, et al.	High Positive End-Expiratory Pressure Allows Extubation of an Obese Patient.	*Am J Respir Crit Care Med.* ***2018 Aug***

Introduction: A 59-year-old man with a body mass index of 47 kg/m^2 was admitted to the ICU with septic shock. After intubation, positive end-expiratory pressure (PEEP) was titrated to 16 cm H_2O after measuring the transpulmonary pressure gradient, as previously described …

ES	Yoshida T, et a l.	Reverse Triggering Causes an Injurious Inflation Pattern during Mechanical Ventilation.	*Am J Respir Crit Care Med.* ***2018 Jun***

Abstract: Patient-ventilator asynchrony occurs in >25% of patients (1), and is associated with prolonged duration of mechanical ventilation (2) and increased mortality (3). Reverse triggering occurs in heavily sedated patients, where mechanical insufflation triggers diaphragm contraction (4). While reverse triggering appears to be common (4), many studies of asynchrony have not included it (2, 3, 5, 6), thus its impact is unknown.
Strong effort during mechanical ventilation -even if synchronized- may cause injurious inflation, including Pendelluft, i.e. the early inspiratory transfer of gas from non-dependent to dependent lung (7- 9). In this setting, strong effort may cause dependent overstretch and tidal recruitment, worsening lung injury in dependent lung despite a low tidal volume (V_T) (7-9). Since reverse triggering is commonly associated with large swings in esophageal pressure, we wondered if the regional inflation associated with reverse triggering is injurious.
We investigate this in a patient with ARDS and in a laboratory setting (anesthetized pigs, ventilator-induced lung injury) using standard ventilator monitoring, electrical impedance tomography (EIT), and esophageal manometry.

CR	Desîlets A, et al.	Visualizing Heterogeneous Pulmonary Ventilation. Respiratory Failure due to an Anterior Mediastinal Mass.	*Am J Respir Crit Care Med.* ***2018 Jun***

Case Description: A patient developed life-threatening central airway obstruction due to an anterior mediastinal mass. Bronchoscopy demonstrated significant compression of the carina with complete collapse of the right mainstem bronchus. To maintain adequate ventilation, the patient required a high positive end-expiratory pressure (PEEP) of 27 cm H2O. Decreasing PEEP from 27 cm H2O to 22 cm H2O (without modifying the applied inspiratory pressure) markedly reduced the tidal volume and end-expiratory lung volume as measured by electrical impedance tomography (EIT) although these changes varied markedly between lung regions. The patient developed a left pneumothorax while awaiting definitive intervention.
A “Y-stent” was eventually inserted in the carina, after which target tidal volumes were achieved with much lower ventilatory pressures.

CR	**Krueger-Ziolek S, et al.**	**Evaluating the Severity of Cystic Fibrosis related Lung Disease by Electrical Impedance Tomography**	*Int Conf Biom Appl EIT* ***2018 Jun***

Abstract: Electrical Impedance Tomography (EIT) derived parameters indicating regional airway obstruction were correlated with the 'Total Brody Score (TBS)' from a computerized tomography (CT) scanning scoring system to investigate the suitability of EIT to evaluate the severity of cystic fibrosis (CF) related lung disease.

CLIN	**Karsten J, et al.**	**Determination of optimal positive end-expiratory pressure based on respiratory compliance and electrical impedance tomography: a pilot clinical comparative trial**	*Biomed. Eng.-Biomed. Tech.* ***2018 May***

Abstract: There is no agreement on gold standard method for positive end-expiratory pressure (PEEP) titration. Electrical impedance tomography (EIT) may aid in finding the optimal PEEP level. In this pilot trial, we investigated potential differences in the suggested optimal PEEP (*BestPEEP*) as derived by respiratory compliance and EITderived parameters. We examined if compliance-derived PEEP differs with regard to the regional ventilation distribution in relation to atelectasis and hyperinflation. Measurements were performed during an incremental/ decremental PEEP trial in 15 ventilated intensive care patients suffering from mild-to-moderate impairment of oxygenation due to sepsis, pneumonia, trauma and metabolic and ischemic disorders. Measurement agreement was analyzed using Bland-Altman plots. We observed a diversity of EIT-derived and compliance-based optimal PEEP in the evaluated patients. $BestPEEP_{Compliance}$ did not necessarily correspond to the $BestPEEP_{ODCL}$ with the least regional overdistension and collapse. The collapsed area was significantly smaller when the overdistension/collapse index was used for PEEP definition ($p = 0.022$). Our results showed a clinically relevant difference in the suggested optimal PEEP levels when using different parameters for PEEP titration. The compliance-derived PEEP level revealed a higher proportion of residual regional atelectasis as compared to EIT-based PEEP.

CLIN	**Heines SJH, et al.**	**Clinical implementation of electric impedance tomography in the treatment of ARDS: a single centre experience**	*Journal of Clinical Monitoring and Computing* ***2018 May***

Abstract: To report on our clinical experience using EIT in individualized PEEP titration in ARDS. Using EIT assessment, we optimized PEEP settings in 39 ARDS patients. The EIT PEEP settings were compared with the physicians' PEEP settings and the PEEP settings according to the ARDS network. We defined a PEEP difference equal to or greater than 4 cm H_2O As clinically relevant. Changes in lung compliance and PaO_2/ FiO_2-ratio were compared in patients with EIT-based PEEP adjustments and in patients with unaltered PEEP. In 28% of the patients, the difference in EIT-based PEEP and physician-PEEP was clinically relevant; in 36%, EIT-based PEEP and physician-PEEP were equal. The EIT-based PEEP disagreed with the PEEP settings according to the ARDS network. Adjusting PEEP based upon EIT led to a rapid increase in lung compliance and PaO_2/FiO_2-ratio. However, this increase was also observed in the group where the PEEP difference was less than 4 cm H_2O. We hypothesize that this can be attributed to the alveolar recruitment during the PEEP trial. EIT based individual PEEP setting appears to be a promising method to optimize PEEP in ARDS patients. The clinical impact, however, remains to be established.

Dräger

CLIN	Aditianingsih D, et al.	**Difference in lung distribution of ventilation between positive end-expiratory pressure 5 cmH_2O and 10 cmH_2O in postoperative patients using electrical impedance tomography assessment**	*Anestezjologia i Ratownictwo* ***2018 Mar***

Background: Atelectasis is one of the most common perioperative respiratory complications seen in the first 24 hours postoperatively and it can actually persist for several days afterwards. Application of Positive End-Expiratory Pressure (PEEP) can prevent postoperative alveolar collapse which is behind atelectasis. The study compares the influence of PEEP either 5 cmH_2O (PEEP-5) or 10 cmH_2O (PEEP-10) on the distribution of ventilation in postoperative patients using Electrical Impedance Tomography (EIT).

Material and methods: A single-blind randomized clinical trial was conducted in the Intensive Care Unit of University Hospital upon 35 patients. The subjects were randomized into two groups: either postoperative mechanical ventilation with PEEP-5 or with PEEP-10. The patients were monitored with EIT PulmoVista 500® with values of the following parameters being taken: global Tidal Impedance Variation (gTIV), regional Tidal Impedance Variation (rTIV) for both anterior and posterior parts of the lungs, global End-Expiratory Lung Impedance (gEELI), regional End-Expiratory Lung Impedance (rEELI) for both anterior and posterior parts of the lungs, Regional Dynamic Compliance Change (RC) for both anterior and posterior parts of the lungs. Then the calculated parameters and their relationship were analyzed for PEEP-5 and PEEP-10 group over time points taken (0-20-40-60 min) and lung regions (anterior/posterior).

Results: Analysis of rTIV and gTIV values in PEEP-5 and PEEP-10 group have shown statistically significant difference in measurements taken at the 20th minute ($p<0.05$) of the study. The analysis of gEELI and rEELI values taken at both anterior and posterior parts of the lungs in PEEP-5 and PEEP-10 group have shown statistically significant difference in every measurement taken ($p < 0.05$). ΔRC difference values (ΔRC) at both anterior and posterior parts of the lungs between PEEP-5 and PEEP-10 group were statistically significantly different ($p < 0.05$) in every measurement taken. There were no differences between two groups in terms of PaO_2/FiO_2 ratio, the length of intubation and the duration of hospitalization.

Conclusions: Despite statistically significant differences in pulmonary parameters (TIV, EELI, RC) measured between PEEP-5 and PEEP-10 groups short term patients' outcome defined by PaO_2/FiO_2 ratio, the length of intubation and the duration of hospitalization did not differ between both groups.

CR	Kotani T, et al.	**Regional overdistension during prone positioning in a patient with acute respiratory failure who was ventilated with a low tidal volume: a case report**	*Journal of Intensive Care* ***2018 Mar***

Background: Prone positioning may provide a uniform distribution of transpulmonary pressure and contribute to prevent ventilator-induced lung injury. However, despite moderate positive end-expiratory pressure and low tidal volumes, there is still a risk of regional overdistension.

Case presentation: A man with refractory hypoxemia was mechanically ventilated with prone positioning. Although prone positioning with a plateau pressure of 18 cmH_2O and a positive end-expiratory pressure of 8 cmH_2O promptly improved oxygenation, regional ventilation monitoring using electrical impedance tomography initially detected decreased distribution in the dorsal region but increased in the ventral, suggesting overdistension.

Conclusions: Our experience indicates monitoring regional ventilation distribution is useful for decreasing the risk of overdistension during prone positioning.

REV	Barisin S, et al.	**Electrical impedance tomography as ventilation monitoring in ICU patients**	*SIGNA VITAE* **2018 Mar**

Abstract: Electrical impedance tomography (EIT), as a monitoring tool of regional lung ventilation, is radiation-free imaging with high temporal resolution. The most important purpose of EIT is to visualize the distribution of tidal volume in different lung regions especially between dependent (dorsal in supine patients) and non-dependent (ventral in supine patients) regions.
Many clinical studies evaluated the applicability of PulmoVista® 500 (Dräger Medical GmbH, Lübeck, Germany) and similar EIT devices in estimating optimal PEEP after recruitment maneuvers (RM) in lung healthy patients and acute respiratory distress syndrome (ARDS), ventilation distribution in cystic fibrosis, COPB, pneumonia and respiratory diseases syndrome in infants.

CLIN	Becher T, et al.	**Characteristic pattern of pleural effusion in electrical impedance tomography images of critically ill patients.**	*British Journal of Anaesthesia* **2018 Mar** (Epub)

Background: Electrical impedance tomography (EIT) is increasingly used for continuous monitoring of ventilation in intensive care patients. Clinical observations in patients with pleural effusion show an increase in out-of-phase impedance changes. We hypothesised that out-of-phase impedance changes are a typical EIT finding in patients with pleural effusion and could be useful in its detection.

Methods: We conducted a prospective observational study in intensive care unit patients with and without pleural effusion. In patients with pleural effusion, EIT data were recorded before, during, and after unilateral drainage of pleural effusion. In patients with no pleural effusion, EIT data were recorded without any intervention. EIT images were separated into four quadrants of equal size. We analysed the sum of out-of-phase impedance changes in the affected quadrant in patients with pleural effusion before, during, and after drainage and compared it with the sum of out-of-phase impedance changes in the dorsal quadrants of patients without pleural effusion.

Results: We included 20 patients with pleural effusion and 10 patients without pleural effusion. The median sum of out-of-phase impedance changes was 70 (interquartile range 49–119) arbitrary units (a.u.) in patients with pleural effusion before drainage, 25 (12–46) a.u. after drainage ($P<0.0001$) and 11 (6–17) a.u. in patients without pleural effusion ($P<0.0001$ vs pleural effusion before drainage). The area under the receiver operating characteristics curve was 0.96 (95% limits of agreement 0.91–1.01) between patients with pleural effusion before drainage and those without pleural effusion.

Conclusions: In patients monitored with EIT, the presence of out-of-phase impedance changes is highly suspicious of pleural effusion and should trigger further examination.

Dräger

CLIN	Ngo C, et al.	**Flow-volume loops measured with electrical impedance tomography in pediatric patients with asthma.**	*Pediatr Pulmonol.* ***2018 Feb** (Epub)*

Background: Electrical impedance tomography (EIT) provides information on global and regional ventilation during tidal breathing and mechanical ventilation. During forced expiration maneuvers, the linearity of EIT and spirometric data has been documented in healthy persons. The present study investigates the potential diagnostic use of EIT in pediatric patients with asthma.

Methods: EIT and spirometry were performed in 58 children with asthma (average age ± SD: 11.86 ± 3.13 years), and 58 healthy controls (average age ± SD: 12.12 ± 2.9 years). The correlation between EIT data and simultaneously acquired spirometric data were tested for FEV_1, $FEV_{0.5}$, MEF_{75} , MEF_{50} , and MEF_{25} . Binary classification tests were performed for the EIT-derived Tiffeneau index FEV1 /FVC and the bronchodilator test index ΔFEV_1 . Average flow-volume (FV) loops were generated for patients with pathologic spirometry to demonstrate the feasibility of EIT for graphic diagnosis of asthma.

Results: Spirometry and global EIT-based FV loops showed a strong correlation ($P < 0.001$, $r > 0.9$ in FEV_1 and $FEV_{0.5}$). In all criteria, the binary classification tests yielded high specificity (>93%), a high positive predictive value (≥75%) and a high negative predictive value (>80%), while sensitivity was higher in ΔFEV_1 (86.67%) and lower in FEV_1 /FVC (25% and 35.29%). A typical concave shape of the EIT-derived average FV loops was observed for asthmatic children with improvement after bronchospasmolysis.

Conclusions: Global FV loops derived from EIT correlate well with spirometry. Positive bronchospasmolysis can be observed in EIT-derived FV loops. Flow-volume loops originated from EIT have a potential to visualize pulmonary function.

CLIN	Lee DH, et al.	**Global and Regional Ventilation during High Flow Nasal Cannula in Patients with Hypoxia**	*Acute and Critical Care* ***2018 Jan***

Background: High flow nasal cannula (HFNC) is known to increase global ventilation volume in healthy subjects. We sought to investigate the effect of HFNC on global and regional ventilation patterns in patients with hypoxia.

Methods: Patients were randomized to receive one of two oxygen therapies in sequence: nasal cannula (NC) followed by HFNC or HFNC followed by NC. Global and regional ventilation was assessed using electric impedance tomography.

Results: Twenty-four patients participated. Global tidal variation (TV) in the lung was higher during HFNC (NC, 2,241 ± 1,381 arbitrary units (AU); HFNC, 2,543 ± 1,534 AU; $P < 0.001$). Regional TVs for four iso-gravitational quadrants of the lung were also all higher during HFNC than NC. The coefficient of variation for the four quadrants of the lung was 0.90 ± 0.61 during NC and 0.77 ± 0.48 during HFNC ($P = 0.035$). Within the four gravitational layers of the lung, regional TVs were higher in the two middle layers during HFNC when compared to NC. Regional TV values in the most ventral and dorsal layers of the lung were not higher during HFNC compared with NC. The coefficient of variation for the four gravitational layers of the lung were 1.00 ± 0.57 during NC and 0.97 ± 0.42 during HFNC ($P = 0.574$).

Conclusions: In patients with hypoxia, ventilation of iso-gravitational regions of the lung during HFNC was higher and more homogenized compared with NC. However, ventilation of gravitational layers increased only in the middle layers.

REV	Lobo B, et al.	Electrical impedance tomography	ATM, Vol.6 . **2018 Jan**

Abstract: Continuous assessment of respiratory status is one of the cornerstones of modern intensive care unit (ICU) monitoring systems. Electrical impedance tomography (EIT), although with some constraints, may play the lead as a new diagnostic and guiding tool for an adequate optimization of mechanical ventilation in critically ill patients. EIT may assist in defining mechanical ventilation settings, assess distribution of tidal volume and of end-expiratory lung volume (EELV) and contribute to titrate positive end-expiratory pressure (PEEP)/tidal volume combinations. It may also quantify gains (recruitment) and losses (overdistention or derecruitment), granting a more realistic evaluation of different ventilator modes or recruitment maneuvers, and helping in the identification of responders and non-responders to such maneuvers. Moreover, EIT also contributes to the management of life-threatening lung diseases such as pneumothorax, and aids in guiding fluid management in the critical care setting. Lastly, assessment of cardiac function and lung perfusion through electrical impedance is on the way.

ES	Da Silva Ramos FJ, et al.	Estimation of Stroke Volume and Stroke Volume Changes by Electrical Impedance Tomography	Anesth Analg. **2018 Jan**

Background: Electrical impedance tomography (EIT) is a noninvasive imaging method that identifies changes in air and blood volume based on thoracic impedance changes. Recently, there has been growing interest in EIT to measure stroke volume (SV). The objectives of this study are as follows: (1) to evaluate the ability of systolic impedance variations (ΔZsys) to track changes in SV in relation to a baseline condition; (2) to assess the relationship of ΔZsys and SV in experimental subjects; and (3) to identify the influence of body dimensions on the relationship between ΔZsys and SV.

Methods: Twelve Agroceres pigs were instrumented with transpulmonary thermodilution catheter and EIT and were mechanically ventilated in a random order using different settings of tidal volume (V_T) and positive end-expiratory pressure (PEEP): V_T 10 mL·kg^{-1} and PEEP 10 cm H_2O, V_T 10 mL·kg^{-1} and PEEP 5 cm H_2O, V_T 6 mL·kg^{-1} and PEEP 10 cm H_2O, and VT 6 mL·kg^{-1} and PEEP 5 cm H_2O. After baseline data collection, subjects were submitted to hemorrhagic shock and successive fluid challenges.

Results: A total of 204 paired measurements of SV and ΔZsys were obtained. The 4-quadrant plot showed acceptable trending ability with a concordance rate of 91.2%. Changes in ΔZsys after fluid challenges presented an area under the curve of 0.83 (95% confidence interval, 0.74-0.92) to evaluate SV changes. Conversely, the linear association between ΔZsys and SV was poor, with R^2 from linear mixed model of 0.35. Adding information on body dimensions improved the linear association between ΔZsys and SV up to R^2 from linear mixed model of 0.85.

Conclusions: EIT showed good trending ability and is a promising hemodynamic monitoring tool. Measurements of absolute SV require that body dimensions be taken into account.