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TITLE: Lung Density Distribution in Dynamic CT Correlates with Oxygenation During Pressure-Controlled Ventilation of Pigs with Lavage-ARDS

AUTHORS: K. Markstaller, B. Eberle, H.-U. Kauczor*, M. Aranda, A. Bink*, N. Weiler

AFFILIATION: Departments of Anesthesiology, and *Radiology Johannes Gutenberg-University, Mainz, Germany

Fast dynamic computed tomography (CT) allows real-time imaging of ventilation and recruitment processes ARDS lungs (1). The purpose of this study was to quantify these processes by CT using defined density ranges, and to correlate the ventilation-induced changes in lung density distribution with oxygenation.

Material and Methods:
With Animal Care Committee approval, 6 anesthetized pigs underwent pressure-controlled ventilation (FiO_2 = 1, I:E = 1:1) before and after induction of lavage ARDS. Mean airway pressure (Pawm) was varied (8, 13, 18, 23, 28, 33, and 38 mbar). At every Pawm level, dynamic CT acquisitions were performed over several respiratory cycles (Somatom Plus4, Siemens; supradiaphragmatical, cross-sectional slice; 1 mm slice thickness; temporal resolution, 100 ms). During scanning at each Pawm, arterial and mixed venous blood was obtained for blood gas analysis and shunt calculation. In every CT image, the fractional areas (FA) of defined density ranges (2) (ventilated lung area: healthy lungs, –910 to –700 HU; ARDS, –910 to –300 HU; atelectatic lung area: -300 to +200 HU (2)) were determined planimetrically. FA results of individual 100 ms-scans were integrated over several respiratory cycles and expressed as mean FA in % of total lung area for each Pawm. Arterial oxygenation (PaO_2) and shunt fraction were correlated with mean FA for both the ventilated lung area, and for atelectasis.

Results: Mean FA for ventilated lung area correlated positively with PaO_2 (healthy lungs: R = + 0.85; ARDS lungs: R = + 0.80)

There was a negative correlation between mean FA for atelectasis and PaO_2 (healthy lungs - 0.79; ARDS lungs: - 0.89). Consequently, the mean FA for atelectasis correlated closely with the calculated shunt fraction (healthy lungs: R = + 0.73; ARDS lungs: R = + 0.87).
Conclusions: Analysis of the distribution of defined lung density ranges in dynamic CT allows regional and dynamic quantification of lung aeration in porcine lavage ARDS, and its effect on oxygenation. A potential application of this technique is CT-based optimization of ventilator therapy in patients with ARDS.

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References:
(1) J Appl Physiol 85(4): 1533 (1998)
(2) RöFo, 170: 575-580 (1999)

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TITLE: AUTHENTICITY OF THE METI® ANESTHESIA PATIENT SIMULATOR: MEDICAL STUDENTS' PERCEPTION

AUTHORS: J.W. Schweiger, M.D., C. Jackson, P. Preece

AFFILIATION: Department of Anesthesiology, University of South Florida College of Medicine, Tampa, FL 33612

Academicians have attempted to identify the most effective methods for teaching medical students clinical skills. Civetta and Varon[1] questioned the feasibility of educating medical students in a critical care setting. In contrast, Rogers, et al.[2] proposed an elective offered during the senior year of medical school, which focused on cognitive problem-solving and analytical skills. Although their approach was successful in teaching cognitive skills, it did not enhance the acquisition of clinical and/or technical skills. We believed the Anesthesia Patient Simulator (METI, Sarasota, FL) appeared suitable for teaching medical students acute care skills. Thus, we sought to determine how senior medical students would rate a skills training workshop and authenticity of the simulations.

Sixty fourth-year medical students were enrolled in a four hour introductory training session using the anesthesia patient simulator. Five skills, and the use of associated equipment were taught, including 1) manual ventilation of the lungs, 2) direct laryngoscopy and intubation, 3) cricothyroidotomy, 4) chest tube insertion and needle thoracostomy, and 5) cardiopulmonary resuscitation (BLS/ACLS). Students were asked to rate, using a 100 mm linear analog scale (0 = Disagree, 100 = Agree), the degree to which they felt the objectives of the clinical scenarios were met, and whether the simulations were authentic. At the end of the evaluation form, students were asked, in an open ended manner, to comment regarding the general value of the workshop. Linear analog scale date are summarized as mean±SD. Comments were coded according to standard qualitative analysis procedures.

Results of objective and authenticity ratings for each of the five clinical skills taught are summarized in the table. Direct laryngoscopy and intubation received the highest objective rating, while cardiopulmonary resuscitation received the highest rating for authenticity. Chest tube insertion and needle thoracostomy each received the lowest objective and authenticity ratings. "Excellent teaching device," "we should get more of this," "the sessions are too short," "the simulator should be integrated with basic science didactics," and "we should have been using this simulator in our second year" were among the most frequent qualitative assessments advanced by the students.

Objective	Objective Rating	Authenticity Rating
1	92±10	89±10
2	93±7	90±10
3	88±13	86±13
4	86±14	84±12
5	90±17	92±8

These data indicate that the medical students believed the objectives of each scenario were met with varied, but a high-degree of success. Ostensibly, perceived authenticity ratings paralleled the objectives met ratings. We believe the Anesthesia Patient Simulator provides an authentic, but nonthreatening occasion for pedagogical approaches that facilitate medical student learning by doing.

1. Crit Care Med 1995;23:432-433.
2. Crit Care Med 1995;23:575-781.