Online Resource

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Capnodynamic monitoring of lung volume and pulmonary blood flow during alveolar recruitment: a prospective observational study in postoperative cardiac patients

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Table S1. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist for cohort studies (www.equator-network.org)

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract (*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	1, 2 1, 2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3
Objectives	3	State specific objectives, including any prespecified hypotheses	3
Methods			
Study design	4	Present key elements of study design early in the paper	3
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	3
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up (*b*) For matched studies, give matching criteria and number of exposed and unexposed	3-4
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	4-6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	4-6
Bias	9	Describe any efforts to address potential sources of bias	-
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding (*b*) Describe any methods used to examine subgroups and interactions (*c*) Explain how missing data were addressed (*d*) If applicable, explain how loss to follow-up was addressed (*e*) Describe any sensitivity analyses	6
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram	6, Fig 1
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (b) Indicate number of participants with missing data for each variable of interest (c) Summarise follow-up time (eg, average and total amount)	Table 1
Outcome data	15*	Report numbers of outcome events or summary measures over time	7, Fig 2
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included (*b*) Report category boundaries when continuous variables were categorized	7

		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	-
Discussion			
Key results	18	Summarise key results with reference to study objectives	7-8
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	10
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	10-11
Generalisability	21	Discuss the generalisability (external validity) of the study results	10-11
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	11

CALCULATIONS

(i) Arterial content of oxygen (C_aO_2, mL L^{-1}) was calculated as:

$$C_aO_2 = Hb \times 1.39 \times S_aO_2 + P_aO_2 \times 0.03$$

haemoglobin (Hb); arterial oxygen saturation (S_aO_2, %); arterial partial pressure of oxygen (P_aO_2, mm Hg)

(ii) Systemic oxygen delivery index (DO_2I, mL min^{-1} m^{-2}) was calculated as:

$$DO_2I = C_aO_2 \times CI$$

cardiac index (CI, mL min^{-1})

(iii) Shunt fraction (Q_s/Q_t, %) was calculated as:

$$\left(C_{pc}O_2 - C_aO_2\right) / \left(C_{pc}O_2 - C_vO_2\right)$$

using the oxygen content formula as for C_aO_2 with the appropriate substitutions.
pulmonary capillary O_2 content ($C_{pc}O_2$); mixed venous O_2 content (C_vO_2)

(iv) Fractional physiological dead space (V_d/V_t, %) was calculated according to the modified Enghoff formula [1]:

$$\left(P_a CO_2 - \ end - tidal \ CO_2 \right) \ / \ P_a CO_2$$

arterial partial pressure of carbon dioxide (P_aCO_2)

(v) Body surface area (m^2) was calculated by the Dubois formula:

$$weight \ (kg) \ ^{0.425} \times \ height \ (cm) \ ^{0.725} \times \ 0.007184$$

(vi) Predicted body weight [2] (PBW, kg) was calculated as:

$$50 + \ 0.91 \times \ (height, \ cm \ - \ 152.4) \ for \ men$$
$$45.5 + \ 0.91 \times \ (height, \ cm \ - \ 152.4) \ for \ women$$

(vii) Respiratory compliance (Crs) and inspiratory airway resistance (Raw) were determined from the equation of motion using data acquired during capnodynamic monitoring:

$$P_{aw} (t) \ = P_0 + \ R_{aw} \times \ Flow (t) \ + \ E_{rs} \times \ Vol (t)$$

where $P_{aw}(t)$ is the airway pressure wave form at the airway opening, Flow(t) is the flow into the patient, Vol(t) is the volume expansion during the breath, and P_0 represents the pressure in the lung at the beginning of the breath when the volume expansion is zero. P_0, R_{aw} and E_{rs} are unknown mechanical parameters, which were determined from all samples of the waveforms during each breath in a least square error fit procedure. The respiratory system compliance (C_{rs}) was calculated as the inverse of the respiratory elastance, $C_{rs}= 1/E_{rs}$.

REFERENCES:

1. Enghoff H: Volumen inefficax, Bemerkungen zur Frage des schadlichen Raumes. *Upsala Lakareforen Forh* 1938, **44**:191-218

2. Acute Respiratory Distress Syndrome Network, Brower RG, Matthay MA, Morris A, Schoenfeld D, Thompson BT, Wheeler A: Ventilation with lower tidal volumes as compared with traditional tidal volumes for acute lung injury and the acute respiratory distress syndrome. *N Engl J Med* 2000, **342**:1301-1308

Figure S1. End-expiratory lung volume indexed to predicted body weight ($ml.kg^{-1}$) by capnodynamic monitoring at a baseline positive end-expiratory pressure (PEEP) of 5 cmH_2O ($PEEP_{BL-5}$), during incremental PEEP at 10 ($PEEP_{MID-10}$) and 15 ($PEEP_{HIGH-15}$) cmH_2O and following return to PEEP 5 cmH_2O ($PEEP_{RTRN-5}$). Patients with a greater than 10% increase in systemic oxygen delivery index (DO_2I) are denoted by black solid circles (responders, n=27) and patients with any other changes (≤ 10%) are denoted by open circles (non-responders, n=37). Circles and error bars are means and 95%CI. * significant change vs. $PEEP_{BL-5}$ and # significant change responders vs. non-responders ($p<0.05$ by mixed factor ANOVA).