Supplemental material

for

Electrical Impedance Tomography is feasible to assess regional ventilation abnormalities in post-COVID-19 Outpatients

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Content

Calculation of study-specific quantitative EIT parameter

EIT data pre-processing

EIT recordings were exported as raw binary files from the PulmoVista 500 device (Dräger Medical Deutschland GmbH, Lübeck, Germany) and analyzed offline using MATLAB (MathWorks, Natick, MA, USA). Each dataset consisted of a time-resolved sequence of 32×32 impedance images (a so-called “frame”). For each frame, global impedance signal was calculated as the sum of all pixel values:

$$Z_{\mathrm{global}}(t) = \sum_{p \in \Omega} Z_p\,(t)$$

where $Z_{\mathrm{global}}(t)$ denotes the global EIT impedance signal at time point t, $Z_p(t)$ the impedance signal of pixel p at time point t, and Ω the set of pixels included in the lung mask. The global impedance signal was calculated as the sum of all pixel-wise impedance values within the lung mask for each time frame. The global impedance signal $Z_{\mathrm{global}}(t)$ was then smoothed using a moving average filter to improve robustness of respiratory cycle detection (see next section).

Based on the global impedance, global tidal variation was defined as the impedance difference between end-expiratory and end-inspiratory states within each respiratory cycle and served as a surrogate measure of tidal ventilation amplitude rather than absolute tidal volume.

Detection of respiratory cycles

Inspiration onset and expiration onset were identified as local minima and maxima of the smoothed global impedance signal, respectively. Subsequently, only physiologically plausible breathing cycles were retained based on predefined physiological criteria applied to each subject individually, including cycle duration, inspiratory and expiratory phase length, and sufficient global tidal variation.

General approach for parameter calculation

For each valid respiratory cycle, parameter values were calculated for each lung pixel individually. These pixel-wise values were subsequently summarized across all pixels within the lung mask using the median in order to reduce the influence of noise and spatial outliers. For selected analyses, including ventral-dorsal and left-right asynchrony (see below), the lung mask was additionally subdivided into anatomically defined regional masks containing multiple pixels. Finally, the resulting cycle-wise summary measures were averaged across all included respiratory cycles to obtain stable subject-level estimates. The use of the mean for cycle-wise aggregation was not intended to assume normality but to reduce physiological breath-to-breath variability. This sequential

aggregation approach improves robustness against both spatial outliers and temporal variability.

Physiological framework of the MATLAB-based EIT analysis

The analysis focused on three principal domains: intratidal counter-ventilation, regional ventilatory asynchrony, and spatial ventilation heterogeneity, including regional delay patterns and localized hotspot phenomena. Parameters were calculated on a pixel-wise and breath-wise basis and subsequently aggregated across valid breathing cycles to obtain subject-level summary metrics.

Quantification of regional ventilatory asynchrony

Regional ventilation asynchrony was assessed by comparing local impedance dynamics to global respiratory timing. For each pixel *p* and breathing cycle *i*, local inspiratory onset and expiratory onset were identified within a defined temporal window around the corresponding global respiratory extrema. The temporal deviation between local and global timing for pixel *p* and breathing cycle *i* was quantified as:

$$\tau_{p,i} = \frac{|t_{ins,p,i} - t_{ins,i}| + |t_{exp,p,i} - t_{exp,i}|}{2}$$

where $\tau_{p,i}$ denotes the regional ventilatory asynchrony, $t_{ins,p,i}$ and $t_{exp,p,i}$ the local inspiratory and expiratory onsets, and $t_{ins,i}$ and $t_{exp,i}$ the corresponding global inspiratory and expiratory onsets. All timing variables represent discrete frame indices rather than continuous physical time units. Regional asynchrony therefore represents the average temporal deviation of local ventilation dynamics from the global respiratory cycle and is expressed in frames.

Per breathing cycle, regional asynchrony was summarized in two ways: as the median and as the interquartile range (IQR) across all lung pixels in order to reduce the influence of spatial outliers and local signal noise. Subsequently, subject-level values were obtained by averaging these cycle-wise summary measures across all valid breathing cycles to reduce physiological breath-to-breath variability and obtain stable subject-level estimates for regional ventilation asynchrony.

Quantification of intratidal counter ventilation

To capture intratidal regional redistribution phenomena (a Pendelluft-like behavior), frame-to-frame impedance changes were analyzed. For each pixel *p* and breathing cycle *i*, impedance differences during inspiration and expiration were calculated. Counter-ventilation was defined as impedance changes occurring opposite to the expected physiological direction, i.e., negative impedance changes during inspiration and positive impedance changes during expiration. Hence, the counter ventilation for pixel *p* and breathing cycle *i* is defined as

$$COUNTER_{p,i} = \sum_{t=t_{ins,i}}^{t_{exp,i}-1} max(0, -\Delta Z_p(t)) + \sum_{t=t_{exp,i}}^{t_{ins,i+1}-1} max(0, \Delta Z_p(t))$$

with

$$\Delta Z_p(t) = Z_p(t+1) - Z_p(t)$$

where $Z_p(t)$ denotes the impedance signal of pixel p at discrete time index t, $t_{ins,i}$ the global inspiratory onset index of breathing cycle i, $t_{exp,i}$ the corresponding global expiratory onset index, and $t_{ins,i+1}$ the onset index of the subsequent inspiration. The variables t, $t_{ins,i}$, and $t_{exp,i}$ therefore represent discrete frame indices rather than continuous physical time units. The parameter $COUNTER_{p,i}$ therefore quantifies the cumulative amount of impedance change occurring opposite to the expected physiological direction during the respiratory cycle.

Supplemental tables

Supplemental Table 1. Electrical impedance tomography (EIT) parameters of patients with post-COVID-19 syndrome (PCS) and control group.

characteristics	patients with PCS (N = 100)		control group (N = 50)	
	N	distribution	N	distribution
visually assessed nominal EIT parameters				
uneven ventilation distribution; n (%)	100	44 (44.0%)	50	6 (12.0%)
non-ventilated areas; n (%)	100	90 (90.0%)	50	16 (32.0%)
concave lung rim; n (%)	100	81 (81.0%)	50	18 (36.0%)
lung appearance; n (%)	100		50	
normal shaped		6 (6.0%)		16 (32.0%)
almost normal shaped		8 (8.0%)		18 (36.0%)
shaped like a thyroid		3 (3.0%)		1 (2.0%)
shaped like a donut		6 (6.0%)		0 (0.0%)
shaped like a butterfly		8 (8.0%)		3 (6.0%)
almost square-shaped		5 (5.0%)		3 (6.0%)
concave deformed		42 (42.0%)		7 (14.0%)
shaped like a throwstone		3 (3.0%)		1 (2.0%)
shaped like an hourglass		1 (1.0%)		0 (0.0%)
shaped like a rotated L		4 (4.0%)		0 (0.0%)
oval shaped		1 (1.0%)		0 (0.0%)
cone shaped		5 (5.0%)		0 (0.0%)
cherry shaped		5 (5.0%)		0 (0.0%)
shaped like a trapezoid		1 (1.0%)		0 (0.0%)
shaped like an inverted horseshoe		2 (2.0%)		1 (2.0%)
conspicuous lung appearance; n (%)	100	67 (67.0%)	50	11 (22.0%)
visually assessed ordinal EIT parameters				
Pendelluft	100		50	

median (Q1, Q3)		1.00 (1.00, 2.00)		1.00 (0.75, 2.00)
no Pendelluft; n (%)		23 (23.0%)		12 (24.0%)
slight Pendelluft; n (%)		30 (30.0%)		21 (42.0%)
moderate Pendelluft; n (%)		23 (23.0%)		15 (30.0%)
severe Pendelluft; n (%)		24 (24.0%)		2 (4.0%)
pathologic Pendelluft; n (%)	100	47 (47.0%)	50	17 (34.0%)
metric EIT parameters				
respiratory rate, in breaths per minute; median (Q1, Q3)	100	5.50 (4.25, 6.00)	50	6.00 (5.75, 8.00)
RVD; median (Q1, Q3)	100	16.00 (10.00, 22.00)	50	12.00 (9.75, 15.00)
SD of RVD; median (Q1, Q3)	100	7.22 (5.78, 10.45)	50	13.52 (9.38, 21.14)
relative ventilation in ROI, in percentage; median (Q1, Q3)	100		50	
ROI 1		27.00 (23.00, 31.00)		26.00 (23.00, 29.00)
ROI 2		24.00 (20.25, 29.00)		26.00 (24.00, 29.00)
ROI 3		25.00 (22.00, 30.00)		23.00 (21.00, 27.00)
ROI 4		20.00 (17.00, 23.75)		20.00 (18.00, 23.25)
tidal volume global, in 10^{14}; median (Q1, Q3)	97	3.51 (1.93, 4.61)	50	5.17 (1.51, 6.32)
ventilation asynchrony (IQR), in DFI; median (Q1, Q3)	97	475.00 (24.50, 2.72*10^{14})	50	275.00 (7.75, 1.32*10^{14})
ventilation asynchrony (SD), in 10^{14} DFI; median (Q1, Q3)	97	2.71 (1.67, 3.16)	50	1.78 (1.40, 2.37)
ventral-dorsal asynchrony, in DFI; median (Q1, Q3)	97	0.00 (-25.00, 45.00)	50	0.50 (-5.00, 125.00)
left-right asynchrony, in DFI; median (Q1, Q3)	97	-15.00 (-6750.00, 0.00)	50	-25.00 (-56250.00, 0.00)
counter ventilation (median), in 10^{14}; median (Q1, Q3)	97	2.93 (0.78, 4.47)	50	3.01 (1.35, 4.35)
counter ventilation (P95), in 10^{14}; median (Q1, Q3)	97	2.24 (1.31, 5.80)	50	3.77 (1.57, 7.20)
global inhomogeneity index; median (Q1, Q3)	100	0.98 (0.95, 1.00)	50	0.94 (0.93, 0.97)

Data are presented as median with first and third quartile (Q1, Q3) for continuous variables, or as absolute and relative frequencies (n, %) for categorical variables. The number of participants (N) included in each group and their respective characteristics are reported. Further abbreviations: –, not applicable / not available; DFI, discrete frame indices; P95, 95th percentile; ROI, region of interest; RVD, regional ventilation delay; SD, standard deviation.

Supplemental Table 2. Results from univariable and multivariable logistic regression modelling assessing the association between the occurrence of the post-COVID-19 syndrome (PCS) and electrical impedance tomography (EIT) parameters.

characteristics	N	univariable		multivariable (adjusted for obesity)			
				EIT parameter		obesity	
		OR (95% CI)	p-value	adjusted OR (95% CI)	p-value	adjusted OR (95% CI)	p-value
visually assessed nominal EIT parameters							
uneven ventilation distribution	147	6.88 (2.51, 18.84)	<0.001	4.71 (1.66, 13.41)	0.004	4.17 (1.45, 11.94)	0.008
non-ventilated areas	147	19.58 (8.01, 47.89)	<0.001	16.05 (6.42, 40.13)	<0.001	4.02 (1.28, 12.62)	0.017
concave lung rim	147	7.68 (3.54, 16.66)	<0.001	7.53 (3.31, 17.15)	<0.001	6.17 (2.09, 18.24)	0.001
conspicuous lung appearance	147	6.73 (3.05, 14.86)	<0.001	5.25 (2.31, 11.90)	<0.001	4.36 (1.51, 12.55)	0.006
visually assessed ordinal EIT parameters							
Pendelluft	147	1.36 (0.96, 1.93)	0.087	1.19 (0.82, 1.73)	0.355	5.88 (2.12, 16.29)	0.001
pathologic Pendelluft	147	1.65 (0.81, 3.36)	0.168	1.24 (0.58, 2.65)	0.574	6.04 (2.18, 16.76)	0.001
metric EIT parameters							
respiratory rate, in breaths per minute	147	0.60 (0.47, 0.76)	<0.001	0.59 (0.45, 0.76)	<0.001	6.45 (2.24, 18.63)	0.001
RVD	147	1.09 (1.03, 1.16)	0.003	1.08 (1.02, 1.15)	0.013	5.53 (1.98, 15.41)	0.001
SD of RVD	147	0.84 (0.78, 0.90)	<0.001	0.86 (0.80, 0.92)	<0.001	3.29 (1.10, 9.84)	0.033
relative ventilation in ROI, in percentage							

ROI 1	147	1.04 (0.97, 1.11)	0.229	1.01 (0.95, 1.09)	0.712	6.13 (2.21, 17.04)	0.001
ROI 2	147	0.92 (0.86, 0.98)	0.009	0.93 (0.87, 0.99)	0.031	5.77 (2.07, 16.03)	0.001
ROI 3	147	1.08 (1.01, 1.15)	0.025	1.07 (1.00, 1.15)	0.063	5.96 (2.15, 16.50)	0.001
ROI 4	147	0.98 (0.91, 1.05)	0.518	1.01 (0.93, 1.10)	0.858	6.44 (2.31, 17.94)	<0.001
tidal volume global, in 10^{14}	144	0.78 (0.66, 0.92)	0.004	0.86 (0.72, 1.02)	0.075	4.84 (1.70, 13.78)	0.003
ventilation asynchrony (IQR), in DFI	144	1.00 (1.00, 1.00)	0.386	1.00 (1.00, 1.00)	0.824	6.04 (2.18, 16.76)	0.001
ventilation asynchrony (SD), in 10^{14} DFI	144	1.36 (1.02, 1.81)	0.034	1.35 (1.01, 1.82)	0.045	6.11 (2.20, 16.96)	0.001
ventral-dorsal asynchrony, in DFI	144	1.00 (1.00, 1.00)	0.588	1.00 (1.00, 1.00)	0.575	6.16 (2.24, 16.94)	<0.001
left-right asynchrony, in DFI	144	1.00 (1.00, 1.00)	0.137	1.00 (1.00, 1.00)	0.073	6.79 (2.40, 19.23)	<0.001
counter ventilation (median), in 10^{14}	144	0.95 (0.82, 1.11)	0.516	0.95 (0.81, 1.12)	0.568	6.13 (2.23, 16.85)	<0.001
counter ventilation (P95), in 10^{14}	144	0.88 (0.77, 0.99)	0.036	0.87 (0.76, 0.99)	0.033	6.40 (2.29, 17.84)	<0.001
global inhomogeneity index	147	202.14 (0.50, 81603.94)	0.083	51.55 (0.98, 2720.25)	0.051	6.45 (2.24, 18.61)	0.001

Besides the number of individuals included in the model (N), the (adjusted) odds ratio (OR) together with the 95% confidence interval (CI) and p-value are provided. Further abbreviations: DFI, discrete frame indices; IQR, interquartile range; P95, 95th percentile; ROI, region of interest; RVD, regional ventilation delay; SD, standard deviation.

Supplemental Table 3. Electrical impedance tomography (EIT) parameters of patients with post-COVID-19 syndrome (PCS) stratified by the occurrence of dyspnea.

characteristics	patients with PCS and dyspnea (N = 76)		patients with PCS without dyspnea (N = 22)	
	N	distribution	N	distribution
visually assessed nominal EIT parameters				
uneven ventilation distribution; n (%)	76	36 (47.4%)	22	8 (36.4%)
non-ventilated areas; n (%)	76	68 (89.5%)	22	20 (90.9%)
concave lung rim; n (%)	76	50 (77.6%)	22	20 (90.9%)
lung appearance; n (%)	76		22	
normal shaped		4 (5.3%)		2 (9.1%)
almost normal shaped		6 (7.9%)		2 (9.1%)
shaped like a thyroid		3 (3.9%)		0 (0.0%)
shaped like a donut		4 (5.3%)		1 (4.5%)
shaped like a butterfly		4 (5.3%)		4 (18.2%)
almost square-shaped		5 (6.6%)		0 (0.0%)
concave deformed		32 (42.1%)		9 (40.9%)
shaped like a throwstone		3 (3.9%)		0 (0.0%)
shaped like an hourglass		1 (1.3%)		0 (0.0%)
shaped like a rotated L		2 (2.6%)		2 (9.1%)
oval shaped		1 (1.3%)		0 (0.0%)
cone shaped		4 (5.3%)		1 (4.5%)
cherry shaped		5 (6.6%)		0 (0.0%)
shaped like a trapezoid		0 (0.0%)		1 (4.5%)
shaped like an inverted horseshoe		2 (2.6%)		0 (0.0%)
conspicuous lung appearance; n (%)	76	53 (69.7%)	22	13 (59.1%)
visually assessed ordinal EIT parameters				
Pendelluft	76		22	

median (Q1, Q3)		1.00 (1.00, 2.00)		2.00 (0.75, 3.00)
no Pendelluft; n (%)		17 (22.4%)		5 (22.7%)
slight Pendelluft; n (%)		24 (31.6%)		5 (22.7%)
moderate Pendelluft; n (%)		17 (22.4%)		6 (27.3%)
severe Pendelluft; n (%)		18 (23.7%)		6 (27.3%)
pathologic Pendelluft; n (%)	76	35 (46.1%)	22	12 (54.5%)
metric EIT parameters				
respiratory rate, in breaths per minute; median (Q1, Q3)	76	6.00 (4.25, 7.00)	22	5.00 (4.00, 6.00)
RVD; median (Q1, Q3)	76	16.00 (9.25, 23.00)	22	14.00 (9.75, 18.25)
SD of RVD; median (Q1, Q3)	76	7.18 (5.53, 11.01)	22	7.04 (6.11, 9.60)
relative ventilation in ROI, in percentage; median (Q1, Q3)	76		22	
ROI 1		28.00 (23.00, 31.75)		27.00 (24.75, 29.00)
ROI 2		24.00 (19.00, 28.00)		25.00 (21.00, 30.00)
ROI 3		25.50 (22.00, 30.00)		25.00 (22.50, 30.00)
ROI 4		20.00 (17.00, 25.00)		19.50 (17.00, 21.50)
tidal volume global, in 10^{14}; median (Q1, Q3)	75	3.50 (2.01, 4.47)	20	3.07 (1.67, 6.14)
ventilation asynchrony (IQR), in DFI; median (Q1, Q3)	75	575.00 (35.00, $3.14*10^{14}$)	20	165.00 (15.00, $1.00*10^{14}$)
ventilation asynchrony (SD), in 10^{14} DFI; median (Q1, Q3)	75	2.79 (2.02, 3.33)	20	2.22 (1.27, 3.03)
ventral-dorsal asynchrony, in DFI; median (Q1, Q3)	75	0.00 (-75.00, 45.00)	20	0.50 (-4.75, 137.50)
left-right asynchrony, in DFI; median (Q1, Q3)	75	-15.00 (-25625.00, -1.00)	20	-5.00 (-25.75, 3.75)
counter ventilation (median), in 10^{14}; median (Q1, Q3)	75	2.97 (0.86, 4.59)	20	2.78 (0.39, 4.35)
counter ventilation (P95), in 10^{14}; median (Q1, Q3)	75	2.23 (1.26, 5.78)	20	2.25 (1.70, 5.84)
global inhomogeneity index; median (Q1, Q3)	76	0.98 (0.96, 1.00)	22	0.96 (0.94, 1.00)

Data are presented as median with first and third quartile (Q1, Q3) for continuous variables, or as absolute and relative frequencies (n, %) for categorical variables. The number of participants (N) included in each group and their respective characteristics are reported. Further abbreviations: –, not applicable / not available; DFI, discrete frame indices; P95, 95th percentile; ROI, region of interest; RVD, regional ventilation delay; SD, standard deviation.

Supplemental Table 4. Results from univariable and multivariable logistic regression modelling assessing the association between the occurrence of dyspnea and electrical impedance tomography (EIT) parameters in patients with post-COVID-19 syndrome (PCS).

characteristics	N	univariable		multivariable (adjusted for obesity and asthma)					
				EIT parameter		asthma		obesity	
		OR (95% CI)	p-value	adjusted OR (95% CI)	p-value	adjusted OR (95% CI)	p-value	adjusted OR (95% CI)	p-value
visually assessed nominal EIT parameters									
uneven ventilation distribution	94	1.58 (0.57, 4.41)	0.383	1.30 (0.44, 3.86)	0.631	0.37 (0.09, 1.50)	0.164	2.86 (0.88, 9.26)	0.080
non-ventilated areas	94	0.43 (0.05, 3.69)	0.445	0.39 (0.04, 3.44)	0.395	0.41 (0.10, 1.67)	0.214	3.20 (1.01, 10.13)	0.048
concave lung rim	94	0.40 (0.08, 1.92)	0.254	0.28 (0.05, 1.50)	0.136	0.30 (0.07, 1.29)	0.106	3.65 (1.09, 12.28)	0.036
conspicuous lung appearance	94	1.48 (0.53, 4.10)	0.453	1.21 (0.41, 3.51)	0.730	0.39 (0.10, 1.56)	0.181	2.92 (0.91, 9.38)	0.072
visually assessed ordinal EIT parameters									
Pendelluft	94	0.98 (0.62, 1.56)	0.948	0.93 (0.57, 1.49)	0.751	0.38 (0.10, 1.55)	0.179	3.11 (0.98, 9.93)	0.055
pathologic Pendelluft	94	0.80 (0.30, 2.16)	0.667	0.69 (0.24, 1.95)	0.481	0.40 (0.10, 1.62)	0.199	3.26 (1.01, 10.49)	0.047
metric EIT parameters									
respiratory rate, in breaths per minute	94	1.33 (0.94, 1.89)	0.112	1.34 (0.92, 1.96)	0.127	0.36 (0.09, 1.49)	0.159	2.94 (0.92, 9.38)	0.069
RVD	94	1.05 (0.98, 1.12)	0.161	1.05 (0.98, 1.12)	0.169	0.34 (0.08, 1.41)	0.136	2.95 (0.92, 9.48)	0.069
SD of RVD	94	1.04 (0.92, 1.16)	0.557	1.09 (0.94, 1.26)	0.259	0.40 (0.10, 1.63)	0.200	3.88 (1.14, 13.21)	0.030
relative ventilation in ROI, in percentage									

ROI 1	94	1.00 (0.92, 1.10)	0.946	0.96 (0.87, 1.07)	0.474	0.35 (0.09, 1.45)	0.150	3.54 (1.03, 12.14)	0.045
ROI 2	94	0.95 (0.87, 1.03)	0.189	0.92 (0.83, 1.01)	0.080	0.23 (0.05, 1.06)	0.060	3.44 (1.03, 11.49)	0.044
ROI 3	94	1.03 (0.94, 1.12)	0.532	1.05 (0.96, 1.16)	0.282	0.30 (0.07, 1.30)	0.108	3.27 (1.01, 10.57)	0.047
ROI 4	94	1.05 (0.95, 1.16)	0.351	1.13 (0.99, 1.28)	0.065	0.25 (0.06, 1.13)	0.072	4.72 (1.31, 17.05)	0.018
tidal volume global, in 10^{14}	91	0.92 (0.71, 1.19)	0.517	1.00 (0.76, 1.32)	0.994	0.32 (0.08, 1.33)	0.117	3.62 (0.97, 13.54)	0.056
ventilation asynchrony (IQR), in DFI	91	1.00 (1.00, 1.00)	0.534	1.00 (1.00, 1.00)	0.721	0.32 (0.08, 1.33)	0.116	3.51 (0.99, 12.48)	0.052
ventilation asynchrony (SD), in 10^{14} DFI	91	1.40 (0.94, 2.11)	0.100	1.43 (0.93, 2.19)	0.104	0.35 (0.08, 1.51)	0.162	3.92 (1.07, 14.37)	0.039
ventral-dorsal asynchrony, in DFI	91	1.00 (1.00, 1.00)	0.993	1.00 (1.00, 1.00)	0.915	0.32 (0.08, 1.33)	0.116	3.62 (1.03, 12.76)	0.045
left-right asynchrony, in DFI	91	1.00 (1.00, 1.00)	0.130	1.00 (1.00, 1.00)	0.109	0.26 (0.06, 1.16)	0.077	3.69 (1.02, 13.31)	0.046
counter ventilation (median), in 10^{14}	91	1.05 (0.84, 1.32)	0.645	1.06 (0.85, 1.34)	0.592	0.32 (0.08, 1.36)	0.124	3.67 (1.04, 12.94)	0.043
counter ventilation (P95), in 10^{14}	91	0.97 (0.80, 1.17)	0.744	0.95 (0.77, 1.16)	0.582	0.31 (0.07, 1.29)	0.107	3.69 (1.04, 13.09)	0.043
global inhomogeneity index	94	0.78 (0.01, 66.65)	0.913	0.36 (0.00, 44.78)	0.677	0.38 (0.09, 1.52)	0.170	3.16 (0.99, 10.08)	0.053

Besides the number of individuals included in the model (N), the (adjusted) odds ratio (OR) together with the 95% confidence interval (CI) and p-value are provided. Further abbreviations: DFI, discrete frame indices; IQR, interquartile range; P95, 95th percentile; ROI, region of interest; RVD, regional ventilation delay; SD, standard deviation.

Supplemental Table 5. Electrical impedance tomography (EIT) parameters of the control group stratified by the occurrence of a COVID-19 infection.

characteristics	control group with infection (N = 30)		control group without infection (N = 20)	
	N	distribution	N	distribution
visually assessed nominal EIT parameters				
uneven ventilation distribution; n (%)	30	2 (6.7%)	20	4 (20.0%)
non-ventilated areas; n (%)	30	10 (33.3%)	20	6 (30.0%)
concave lung rim; n (%)	30	12 (40.0%)	20	6 (30.0%)
lung appearance; n (%)	30		20	
normal shaped		9 (30.0%)		7 (35.0%)
almost normal shaped		12 (40.0%)		6 (30.0%)
shaped like a thyroid		0 (0.0%)		1 (5.0%)
shaped like a donut		0 (0.0%)		0 (0.0%)
shaped like a butterfly		0 (0.0%)		3 (15.0%)
almost square-shaped		2 (6.7%)		1 (5.0%)
concave deformed		5 (16.7%)		2 (10.0%)
shaped like a throwstone		1 (3.3%)		0 (0.0%)
shaped like an hourglass		0 (0.0%)		0 (0.0%)
shaped like a rotated L		0 (0.0%)		0 (0.0%)
oval shaped		0 (0.0%)		0 (0.0%)
cone shaped		0 (0.0%)		0 (0.0%)
cherry shaped		0 (0.0%)		0 (0.0%)
shaped like a trapezoid		0 (0.0%)		0 (0.0%)
shaped like an inverted horseshoe		1 (3.3%)		0 (0.0%)
conspicuous lung appearance; n (%)	30	8 (26.7%)	20	3 (15.0%)
visually assessed ordinal EIT parameters				
Pendelluft	30		20	

median (Q1, Q3)		1.00 (1.00, 2.00)		1.00 (0.00, 1.00)
no Pendelluft; n (%)		5 (16.7%)		7 (35.0%)
slight Pendelluft; n (%)		11 (36.7%)		10 (50.0%)
moderate Pendelluft; n (%)		12 (40.0%)		3 (15.0%)
severe Pendelluft; n (%)		2 (6.7%)		0 (0.0%)
pathologic Pendelluft; n (%)	30	14 (46.7%)	20	3 (15.0%)
metric EIT parameters				
respiratory rate, in breaths per minute; median (Q1, Q3)	30	6.00 (5.00, 8.00)	20	7.00 (6.00, 8.75)
RVD; median (Q1, Q3)	30	11.50 (8.75, 15.00)	20	14.50 (11.00, 18.50)
SD of RVD; median (Q1, Q3)	30	12.67 (8.99, 20.38)	20	14.26 (9.43, 22.27)
relative ventilation in ROI, in percentage; median (Q1, Q3)	30		20	
ROI 1		26.00 (23.75, 29.00)		26.00 (23.00, 28.75)
ROI 2		26.50 (22.00, 29.00)		26.00 (24.25, 28.75)
ROI 3		22.50 (20.75, 26.25)		23.00 (22.00, 27.00)
ROI 4		20.00 (18.00, 23.25)		21.00 (18.25, 23.75)
tidal volume global, in 10^{14}; median (Q1, Q3)	30	5.31 (1.44, 6.42)	20	5.01 (1.82, 6.34)
ventilation asynchrony (IQR), in DFI; median (Q1, Q3)	30	60.50 (6.50, $0.32*10^{14}$)	20	850.00 (14.75, $2.29*10^{14}$)
ventilation asynchrony (SD), in 10^{14} DFI; median (Q1, Q3)	30	1.68 (1.32, 2.38)	20	1.90 (1.45, 2.35)
ventral-dorsal asynchrony, in DFI; median (Q1, Q3)	30	0.00 (-22.50, 25.00)	20	50.00 (-3.75, 6875.00)
left-right asynchrony, in DFI; median (Q1, Q3)	30	-4.50 ($-0.26*10^{14}$, 0.00)	20	-120.00 (-61562.50, -0.25)
counter ventilation (median), in 10^{14}; median (Q1, Q3)	30	3.08 (1.47, 5.06)	20	2.70 (1.30, 4.06)
counter ventilation (P95), in 10^{14}; median (Q1, Q3)	30	3.55 (1.60, 7.48)	20	3.82 (1.28, 7.01)
global inhomogeneity index; median (Q1, Q3)	30	0.94 (0.93, 0.97)	20	0.95 (0.94, 0.97)

Data are presented as median with first and third quartile (Q1, Q3) for continuous variables, or as absolute and relative frequencies (n, %) for categorical variables. The number of participants (N) included in each group and their respective characteristics are reported. Further abbreviations: –, not applicable / not available; DFI, discrete frame indices; P95, 95th percentile; ROI, region of interest; RVD, regional ventilation delay; SD, standard deviation.

Supplemental Table 6. Results from univariable and multivariable logistic regression modelling assessing the association between the occurrence of the COVID-19 disease and electrical impedance tomography (EIT) parameters in the control group.

characteristics	N	univariable		multivariable (adjusted for obesity)			
				EIT parameter		obesity	
		OR (95% CI)	p-value	adjusted OR (95% CI)	p-value	adjusted OR (95% CI)	p-value
visually assessed nominal EIT parameters							
uneven ventilation distribution	48	0.36 (0.05, 2.38)	0.287	0.33 (0.04, 2.49)	0.280	1.32 (0.16, 10.74)	0.798
non-ventilated areas	48	1.30 (0.36, 4.68)	0.688	1.31 (0.36, 4.72)	0.682	0.87 (0.13, 5.79)	0.882
concave lung rim	48	1.73 (0.49, 6.13)	0.394	1.73 (0.49, 6.17)	0.398	0.97 (0.14, 6.60)	0.978
conspicuous lung appearance	48	1.82 (0.41, 7.99)	0.429	1.86 (0.42, 8.34)	0.415	0.79 (0.11, 5.46)	0.811
visually assessed ordinal EIT parameters							
Pendelluft	48	2.21 (0.98, 4.96)	0.055	2.37 (1.02, 5.50)	0.044	0.49 (0.06, 3.84)	0.495
pathologic Pendelluft	48	4.37 (1.04, 18.32)	0.043	4.75 (1.08, 20.90)	0.039	0.56 (0.07, 4.50)	0.583
metric EIT parameters							
respiratory rate, in breaths per minute	48	0.72 (0.50, 1.04)	0.082	0.70 (0.47, 1.03)	0.069	0.53 (0.07, 4.05)	0.538
RVD	48	0.92 (0.80, 1.06)	0.231	0.91 (0.79, 1.06)	0.228	1.19 (0.17, 8.54)	0.862
SD of RVD	48	0.98 (0.92, 1.05)	0.578	0.98 (0.92, 1.05)	0.544	0.76 (0.11, 5.42)	0.786
relative ventilation in ROI, in percentage							

ROI 1	48	1.03 (0.88, 1.21)	0.699	1.03 (0.88, 1.21)	0.702	0.90 (0.14, 6.02)	0.915
ROI 2	48	0.98 (0.86, 1.12)	0.806	0.97 (0.84, 1.13)	0.727	0.73 (0.08, 6.47)	0.781
ROI 3	48	0.98 (0.87, 1.12)	0.789	0.98 (0.85, 1.14)	0.811	1.02 (0.11, 9.36)	0.985
ROI 4	48	0.97 (0.81, 1.17)	0.756	0.97 (0.81, 1.17)	0.764	0.91 (0.14, 6.15)	0.927
tidal volume global, in 10^{14}	48	0.96 (0.76, 1.22)	0.740	0.95 (0.74, 1.22)	0.700	0.79 (0.11, 5.78)	0.815
ventilation asynchrony (IQR), in DFI	48	1.00 (1.00, 1.00)	0.141	1.00 (1.00, 1.00)	0.139	1.19 (0.15, 9.17)	0.868
ventilation asynchrony (SD), in 10^{14} DFI	48	0.97 (0.68, 1.40)	0.880	0.97 (0.68, 1.40)	0.880	0.89 (0.13, 5.91)	0.904
ventral-dorsal asynchrony, in DFI	48	1.00 (1.00, 1.00)	0.266	1.00 (1.00, 1.00)	0.267	0.90 (0.13, 6.11)	0.918
left-right asynchrony, in DFI	48	1.00 (1.00, 1.00)	0.453	1.00 (1.00, 1.00)	0.426	0.73 (0.10, 5.28)	0.759
counter ventilation (median), in 10^{14}	48	1.07 (0.80, 1.44)	0.639	1.09 (0.80, 1.49)	0.581	0.72 (0.09, 5.56)	0.753
counter ventilation (P95), in 10^{14}	48	0.98 (0.80, 1.19)	0.844	0.98 (0.80, 1.19)	0.845	0.89 (0.13, 5.92)	0.905
global inhomogeneity index	48	0.00 (0.00, 158995.14)	0.367	0.00 (0.00, 893354.39)	0.425	0.78 (0.09, 6.78)	0.823

Besides the number of individuals included in the model (N), the (adjusted) odds ratio (OR) together with the 95% confidence interval (CI) and p-value are provided. Further abbreviations: DFI, discrete frame indices; IQR, interquartile range; P95, 95th percentile; ROI, region of interest; RVD, regional ventilation delay; SD, standard deviation.