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Descriptive values of static compliance and their comparison between 0.5 and 2.0-second inspiratory pauses in mechanically ventilated patients: a cross-sectional study

Valores descritivos de complacência estática e sua comparação entre pausas inspiratórias de 0,5 e 2,0 segundos em pacientes ventilados mecanicamente: um estudo transversal

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Abstract

Background: Studies point to quasi-static respiratory system compliance (Cest) intervals ranging from 50 to 70 ml/cmH_2O – independent of the inspiratory pause time (0.5 or 2.0 seconds), however it has been observed that these values are impractical in daily practice. **Aim**: To describe and compare Cest values using 0.5 and 2.0-second pauses, compare pulmonary mechanics measurements between patients with and without pulmonary alterations, and correlate anthropometric and ventilatory data with Cest. **Methods**: This was a cross-sectional and prospective study. Anthropometric and pulmonary mechanics data were collected, including Cest and driving pressure (DP), using inspiratory pauses of 0.5 and 2.0 seconds for each assessment. The sample was characterized according to the presence of comorbidities. **Results**: Thirty-five patients were included, of whom 47.5% (16) were women, with a median age of 62 (interquartile range [IQR] 47.0–74.0) years, and a median height of 166.0 cm (160.0–172.0). Eighty percent were clinical profile. The median Cest was 37.2 ml/cmH2O (30.2–46.6) and DP was 9.0 cmH2O (7.8–10.9). There was a statistically significant difference ($p<0.01$) in Cest and DP values between the 0.5 and 2.0-second pauses in the total sample and in the group with pulmonary affection. The correlations between Cest at 2.0 seconds with DP and height were moderate and statistically significant ($p<0.01$). **Conclusion**: Based on the analyzed data, the median Cest was 37.2 cmH2O. Inspiratory pause may affect pulmonary mechanics values in patients with pulmonary affections due to the multicompartmental properties of the lung parenchyma, indicating a possible heterogeneity.

Keywords: Lung Compliance; Respiratory Mechanics; Reference Values; Mechanical Ventilation.

Resumo

Introdução: Estudos apontam intervalos de complacência quasiestática do sistema respiratório (Cest) variando entre 50 a 70 ml/cmH_2O – independente do tempo de pausa inspiratória (0,5 ou 2,0 segundos), no entanto tem sido observado que esses valores são impraticáveis cotidianamente. **Objetivo**: descrever e comparar os valores de Cest através de pausas de 0,5 e 2,0 segundos, comparar as medidas de mecânica pulmonar entre pacientes com e sem alterações pulmonares e correlacionar dados antropométricos e ventilatórios com a Cest. **Método**: trata-se de um estudo transversal e prospectivo. Foram coletados dados antropométricos e de mecânica pulmonar, dentre eles a Cest e pressão de distensão pulmonar (DP), utilizando pausas inspiratórias de 0,5 e 2,0 segundos cada avaliação. A amostra foi caracterizada de acordo com presença de comorbidades. **Resultados**: Foram incluídos 35 pacientes, destes 47,5% (16) mulheres, mediana de idade de 62 (intervalo interquartil [IIQ] 47,0-74,0) anos, com mediana de 166,0cm (160,0-172,0) de altura, 80% eram perfil clínico. A mediana de Cest foi de 37,2ml/cmH_2O (30,2-46,6) e DP de 9,0 cmH_2O (7,8-10,9). Houve diferença estatisticamente significante ($p<0,01$) entre as pausas de 0,5 e 2,0 segundos nos valores de Cest (35,0 e 37,2 ml/cmH_2O) e DP (10,0 e 9,0 cmH_2O) na amostra total. As correlações entre Cest de 2,0 segundos com DP e altura foram moderadas e estatisticamente significantes ($p<0,01$). **Conclusão**: A partir dos dados analisados, a mediana de Cest foi de 37,2 cmH_2O. Diferentes tempos de pausa inspiratória podem afetar valores de mecânica pulmonar em pacientes com afecções pulmonares devido às propriedades multicompartimentais do parênquima pulmonar, indicando uma possível heterogeneidade.

Palavras-chave: Complacência Pulmonar; Mecânica Respiratória; Valores de Referência; Ventilação Mecânica.

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INTRODUCTION

Mechanical ventilation (MV) is a therapeutic intervention that completely or partially replaces a patient's spontaneous breathing, making it an indispensable tool for life support in intensive care units (ICUs). It aims at preventing or reversing respiratory muscle fatigue, improving gas exchange, reducing oxygen consumption, and enabling the administration of specific therapies[1-3].

Although it is an important tool, the use of mechanical ventilation must be approached with caution, as it carries significant risks due to the deterioration of ventilatory mechanics and the increased likelihood of Ventilator-Induced Lung Injury (VILI)[4]. Therefore, ventilatory mechanics should be assessed periodically to detect any changes, using measurements of pressure, flow, and lung volumes. In this case, one of the key measures is quasi-static compliance (CEST), which is the lung distensibility generated by the amount of air per unit of pressure[1,2,5].

The calculation of CEST requires an inspiratory pause of 0.5 to 2 seconds, during which, with zero flow, it is calculated by dividing the tidal volume by the driving pressure (DP), which is obtained by subtracting the plateau pressure (Pplat) from the end-expiratory positive pressure (PEEP)[1,2,5-7].

In this context, the results obtained using the CEST and DP formulas — which are derived from daily bedside assessments—enable the diagnosis of patients with high pulmonary compliance, thereby minimizing exposure to VILI with a protective ventilation strategy[5,8,9]. This strategy, in turn, is characterized by a low tidal volume (VT), 6 ml/kg of predicted body weight (PBW), and a Pplat below 30 cmH_2O. This adjustment/response relationship of the respiratory system allows for the reduction of excessive pulmonary stretching and the triggering of volutrauma, barotrauma, and biotrauma, which in turn directly impact hospital mortality rates and ventilator-free days[8,10].

In daily clinical practice, CEST is used for the assessment and prevention of VILI solely by comparing the patient's current values with their own baseline. However, CEST data reported in recent systematic reviews[1,2] indicate that values between 50 and 70 ml/cmH_2O are considered acceptable for mechanically ventilated patients. Nevertheless, these values may be impractical depending on the patient's height and sex.

For this reason, our primary objective was to describe and compare CEST values using 0.5- and 2.0-second pauses. Our secondary objective was to compare pulmonary mechanics measurements between patients with and without pulmonary abnormalities and to correlate anthropometric and ventilatory data with CEST in patients admitted to a public hospital in the capital of Bahia.

METHOD

This is a cross-sectional study conducted in the ICUs of Hospital do Subúrbio in the city of Salvador, state of Bahia, between March 2022 and January 2024. This study followed the STROBE[11] (STrengthening the Reporting of OBservational studies in Epidemiology) guidelines and was approved by the Research Ethics Committee under CAAE 57895516.8.1001.5028. Data were collected upon the signing of the Informed Consent Form (in person or online) by the guardians of the respective patients.

The study included patients on mechanical ventilation, of both sexes, aged 18 years or older, with no or minimal interaction with the ventilator as visualized through graphical analysis on the ventilator, and with stable hemodynamics, characterized by the absence of or low doses of norepinephrine (0.5 µg/ml/kg/min), no axial fractures or chest wall deformities, and no intrathoracic complications (unresolved pneumothorax or hemothorax). Patients who showed a change in mean arterial pressure greater than 20% from baseline, systolic blood pressure less than 90 mmHg, or peripheral oxygen saturation (SpO_2) less than 90% during ventilatory mechanics measurements were excluded. This study used convenience sampling.

Primary data sources included respiratory mechanics measurements: peak pressure (Ppeak), Pplat, CEST, and resistive pressure (Pres), as well as all secondary values derived from mathematical formulas. This data collection was performed at two different inspiratory pause times (0.5 and 2.0 seconds), with a one-minute interval between each. Sociodemographic data, such as age, sex, reason for admission, date of intubation, and presence of comorbidities, were retrieved from each patient's medical records.

The measurement of patients' quasi-static ventilatory mechanics was performed using Dräger Evita 4® and Dräger Savina® ventilators. Data were collected by physical therapists enrolled in the Intensive Care Residency Program who had previously been trained to perform the assessment. The following ventilation parameters were used for this measurement: volume-controlled ventilation (VCV) mode; VT calculated based on predicted body weight using the ARDSnet formula[12]: 50 + 0.91 (height in centimeters – 152.4) for men and 45.5 + 0.91 (height in centimeters – 152.4) for women, multiplied by 6 ml/kg; respiratory rate (RR) 20 breaths per minute; flow of 40 L/min with a square wave; inspiratory pause initially set at 0.5 seconds for the first measurement of ventilatory mechanics and 2.0 seconds for the second. All patients were evaluated for both pause durations. After adjustments, the following values were calculated: Ppeak, Pplat, CEST ($Cest = \frac{VT}{Pplat - PEEP}$), DP ($DP = Pplat - PEEP$), Pres ($Pres = Ppeak - Pplat$) and CEST PBW ratio (CEST/PBW, $CEST / PBW = CEST / PBW$).

Once all the data had been collected and given the study's pragmatic nature, the sample had to be characterized to distinguish patients with lungs closer to homogeneity (no lung disease — NLD) from those with signs of heterogeneity (lung disease — LD). Therefore, patients with elective intubation for surgical procedures, decreased level of consciousness, stroke, and seizures were allocated to the NLD group. The remaining patients who had pulmonary infections and/or comorbidities such as heart failure, smoking, obesity, and chronic kidney disease were allocated to the LD group.

The Shapiro-Wilk test and histogram plots were used for statistical analysis[13], which revealed a non-normal distribution in most of the data (only the variables height, body weight, and vital capacity followed a normal distribution). Therefore, to ensure that the analyses were conducted on the same basis, the median was used as a measure of central tendency and the interquartile range (IQR) as a measure of dispersion. Categorical data were analyzed using absolute and relative frequencies. For group comparisons, the nonparametric Wilcoxon Rank test was used for paired data and the Mann-Whitney test for unpaired data. Correlations were assessed using Spearman's nonparametric correlation test. A p-value <0.05 was considered statistically significant.

RESULTS

The sample consisted of 35 patients, with a median age of 62 (47.0–74.0) years, of whom 45.7% (16) were female. Demographic data showed a median height of 166.0 (160–172.0) cm and a PBW of 61.0 (52.0–67.0) kg. The profile of these patients revealed that 80% (28) had a medical profile, 20% (7) had a surgical profile, and 34.3% (12) had a pulmonary condition before or during hospitalization. Ventilatory data yielded the following medians: median VC of 360 (310–410) ml, CEST 37.2 (30.2–46.6) ml/cmH_2O, DP of 9.0 (7.8–10.9) cmH_2O, and CEST/PBW of 0.67 (0.60–0.77) ml/cmH_2O/kg. Systemic arterial hypertension was the most common comorbidity (22 patients, 62.9%). Table 1 presents these data.

Regarding the within-group comparison during inspiratory pauses of 0.5 and 2.0 seconds, a significant difference was observed in the total sample and in NLD patients (which may have influenced the overall data) for the variables Pplat, CEST, Pres, DP, and CEST/PBW (all with p<0.05) during the 0.5-second pause. Table 2 shows the complete data.

Table 3 describes the sample according to the patients' ventilatory variables, dividing it into those with and without pulmonary involvement. In this comparison between the groups, only three variables showed a statistically significant difference: Ppeak (p=0.04), Pplat (p=0.02),

Table 1. Demographic, clinical, and ventilatory variables of the study participants. Salvador-BA, 2024.

Variables	Sample (n=35)
Age in years, ME (IQR)	62 (47.0-74.0)
Female, n (%)	16 (45.7)
Height in cm, ME (IQR)	166.0 (160.0-172.0)
PBW in kg, ME (IQR)	61.0 (52.0-67.0)
Clinical profile, n (%)	28 (80.0)
Surgical profile, n (%)	7 (20.0)
Presence of lung disease	12 (34.3)
VT in ml, ME (IQR)	360 (310-410)
CEST# in ml/cmH_2O, ME (IQR)	37.2 (30.2-46.6)
DP# in cmH_2O, ME (IQR)	9.0 (7.8-10.9)
CEST/PBW# in ml/cmH_2O/kg	0.67 (0.60-0.77)
Comorbidities	
SAH, n (%)	22 (62.9)
HF, n (%)	17 (48.6)
DM, n (%)	13 (37.1)
AF, n (%)	6 (17.1)

Legend: n: absolute frequency; %: relative frequency; ME: Median; IQR: Interquartile Range; cm: Centimeters; kg: Kilograms; VT: Tidal volume; ml: milliliters; #Values with a 2.0 second pause; CEST: Quasi-static compliance; cmH_2O: Centimeters of water; DP: Driving pressure; PBW: Predicted body weight; SAH: Systemic arterial hypertension; DM: Diabetes mellitus; HF: Heart failure; AF: Atrial fibrillation.

Source: elaborated by the authors.

and PEEP (p=0.02). All of these were higher in the NLD patient group.

Table 4 presents the correlation analysis of CEST during the two-second pause with demographic and ventilatory variables. The variables described that showed a moderate and statistically significant correlation were VT ($p<0.01$), Ppeak ($p<0.01$), Pplat ($p<0.01$), DP ($p<0.01$), and PBW ($p<0.01$). The correlation between CEST and PBW is best visualized using a scatter plot (Figure 1).

In addition to the correlation analyses between CEST with a two-second pause, the same analysis was also performed between CEST with a 0.5-second pause and PBW, which showed a moderate positive correlation ($r = 0.498$) that was statistically significant ($p < 0.01$). Figure 2 illustrates these results.

DISCUSSION

The median CEST values in mechanically ventilated patients reported in this study were lower than those reported in previous studies[1,2], even in patients considered to have no pre-existing lung conditions. In addition, different pause times (0.5 and 2.0 seconds) were found to directly impact Pplat, CEST, DP, Pres, and PBW values in the overall sample and the NLD category. The moderate correlation with predicted weight was another notable finding, suggesting that this variable may depend on anthropometric data, such as height and sex.

The need to individualize CEST values is critical for the early diagnosis of changes in elastic load in patients on mechanical ventilation. This strategy is needed to prevent mechanical ventilation-induced lung injury, which affects prognosis and duration of mechanical ventilation and is strongly associated with mortality risks[2,8,14].

Because it is a key part of the clinical assessment of patients on mechanical ventilation, the range of values considered acceptable —50 to 70 ml/cmH_2O[1] — needs to be reevaluated. According to a recently published study[15], CEST may be highly dependent on a patient's height and, consequently, on their body weight. In this case, a male with a height of 2.00 m and another male with a height of 1.50 m will have, respectively, 559 ml and 286 ml12 of VT at 6 ml/kg; therefore, considering a DP of 10 cmH_2O for both, the respective CEST for these individuals will be 55.9 ml/cmH_2O and 28.6 ml/cmH_2O[15].

The extubation outcomes of patients being weaned from mechanical ventilation are another key area where CEST values can provide valuable insights. A study by

Table 2. Ventilatory variables in patients with and without pulmonary conditions and their intra-group comparisons. Salvador-BA, 2024.

Variables, median (IQR)	Total (N=35)	Without lung disease (n=23)	With lung disease (n=12)
Ppeak 2.0s (cmH_2O)	23.0 (21.0-28.0)	23.0 (20.0-25.0)	26.5 (23.0-30.75)
Ppeak 0.5s (cmH_2O)	24.0 (20.0-28.0)	23.0 (20.0-25.0)	26.5 (22.0-31.0)
p *value*&	0.91	0.58	0.48
Pplat 2.0s (cmH_2O)	16.0 (14.0-18.0)	15.0 (13.0-16.0)	17.5 (15.2-21.7)
Pplat 0.5s (cmH_2O)	17.0 (13.0-20.0)	15.0 (12.0-18.0)	17.0 (14.0-20.0)
p *value*&	0.02	0.35	< 0.01
CEST 2.0s (ml/cmH_2O)	37.2 (30.2-46.6)	40.0 (33.1-46.6)	35.0 (29.1-46.1)
CEST 0.5s (ml/cmH_2O)	35.0 (28.2-44.2)	37.5 (31.0-51.0)	32.0 (24.3-39.5)
p *value*&	0.03	0.43	0.01
Pres 2.0s (cmH_2O)	8.0 (6.0-9.0)	8.0 (6.0-10.0)	8.5 (7.0-10.7)
Pres 0.5s (cmH_2O)	7.0 (6.0-9.0)	7.0 (6.0-9.0)	7.0 (6.2-8.7)
p *value*&	0.02	0.27	<0.01
DP 2.0s (cmH_2O)	9.0 (7.8-11.0)	9.0 (7.0-11.0)	9.5 (8.1-10.7)
DP 0.5s (cmH_2O)	10.0 (7.0-12.0)	9.0 (7.0-12.0)	10.5 (9.7-12.0)
p *value*&	0.01	0.36	<0.01
CEST/PBW 2.0 (ml/cmH_2O/kg)	0.67 (0.60-0.77)	0.67 (0.60-0.84)	0.63 (0.56-0.73)
CEST/PBW 0.5 (ml/cmH_2O/kg)	0.60 (0.50-0.84)	0.67 (0.50-0.85)	0.57 (0.49-0.62)
p *value*&	0.03	0.55	<0.01

Legend: Ppeak: Peak Pressure; s: seconds; cmH_2O: Centimeters of water; Pplat: Plateau pressure; CEST: Static compliance; Pres: Resistive pressure; DP: Driving pressure; PBW: Kilograms of predicted weight; Kg: Kilogram; &: Wilcoxon test.

Source: elaborated by the authors.

Table 3. Ventilatory variables in patients with and without pulmonary conditions and comparisons between the groups. Salvador-BA, 2024.

Variables, median (IQR)	Total (n=35)	Without lung disease (n=23)	With lung disease (n=12)	p-value*
Age (years)	62.0 (47.0-74.0)	58.0 (45.0-68.0)	70.0 (52.5-81.5)	0.07
Height (cm)	166 (160-172)	166 (160-172)	165 (155-172)	0.64
PBW (kg)	61.0 (52.0-67.0)	61 (52.6-66.0)	60.0 (46.1-68.2)	0.54
VT 6 ml/kg (ml)	360 (310-410)	360 (310-410)	359 (272-407)	0.64
Ppeak# (cmH_2O)	23.0 (21.0-28.0)	23.0 (20.0-25.0)	26.5 (23.0-30.75)	0.04
Pplat# (cmH_2O)	16.0 (14.0-18.0)	15.0 (13.0-16.0)	17.5 (15.2-21.7)	0.02
CEST# (ml/cmH_2O)	37.2 (30.2-46.6)	40.0 (33.1-46.6)	35.0 (29.1-46.1)	0.34
Pres# (cmH_2O)	8.0 (6.0-9.0)	8.0 (6.0-10.0)	8.5 (7.0-10.7)	0.17
DP# (cmH_2O)	9.0 (7.8-10.9)	9.0 (7.0-11.0)	9.5 (8.1-10.7)	0.46
PEEP (cmH_2O)	5.0 (5.0-8.3)	5.0 (4.9-7.9)	9.1 (5.0-11.4)	0.02
CEST/PBW# ($ml/cmH_2O/kg$)	0.67 (0.60-0.77)	0.67 (0.60-0.84)	0.63 (0.56-0.73)	0.54

Legend: cm: centimeters; VT: Tidal Volume; ml: milliliters; #values with a 2.0-second pause; Ppeak: Peak Pressure; cmH_2O: Centimeters of water; Pplat: Plateau Pressure; CEST: Static Compliance; Pres: Resistive Pressure; DP: Driving Pressure; PEEP: Positive End-Expiratory Pressure; PBW: Kilograms of Predicted Weight; Kg: Kilograms; *Mann-Whitney test.

Source: elaborated by the authors.

Table 4. Correlation test between demographic and ventilatory variables and quasi-static compliance during a two-second pause. Salvador-BA, 2024.

Variables	r	p-value
Age (years)	-0.150	0.39
Height (cm)	0.499	<0.01
VT (ml)	0.574	<0.01
Ppeak (cmH_2O)	-0.451	<0.01
Pplat (cmH_2O)	-0.621	<0.01
PEEP (cmH_2O)	-0.185	0.28
DP (cmH_2O)	-0.696	<0.01
PBW (kg)	0.550	<0.01

Legend: r: Spearman's correlation coefficient; VT: Tidal volume; ml: milliliters; cm: centimeters; Ppeak: Peak pressure; Pplat: Plateau pressure; PEEP: Positive End-Expiratory Pressure; DP: Driving pressure; cmH_2O: Centimeters of water; PBW: Kilograms of predicted weight; kg: Kilogram.

Source: elaborated by the authors.

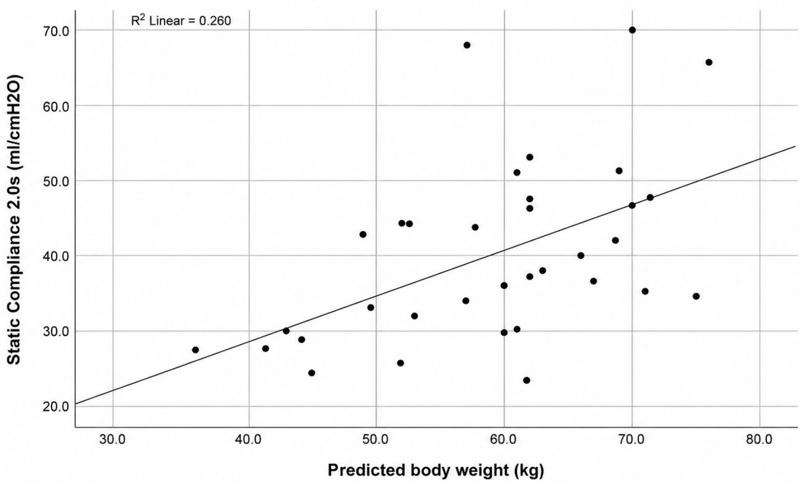

Figure 1. Scatter plot showing the correlation between static compliance (CEST), measured at 2.0 seconds, and predicted weight.
Source: elaborated by the authors.

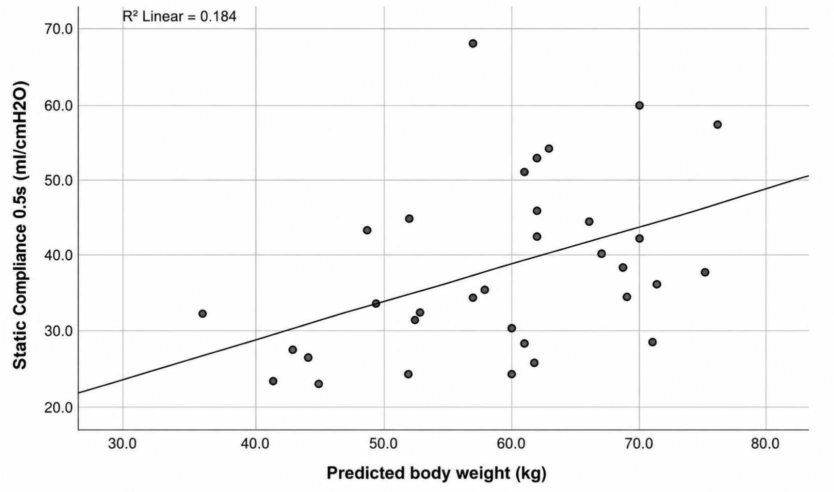

Figure 2. Scatter plot showing the correlation between static compliance (CEST) measured at 0.5 seconds and predicted weight.
Source: elaborated by the authors.

Abplanalp et al.[14] found that patients with a CEST value below 50 ml/cmH_2O had a higher risk of extubation failure, which in turn increased the likelihood of complications related to the duration of MV and mortality.

Another key point to consider is the role of CEST values in predicting patient prognosis. Low CEST values are associated with a higher risk of mortality. According to a study by Oliveira et al.[10] in patients with COVID-19, CEST values below 30 ml/cmH_2O were associated with higher mortality rates, corroborating the study by Kock and Maurici[9], which, in addition to finding a link between ventilator-associated pneumonia and ventilator settings, also associated low CEST with a high probability of mortality.

Therefore, individualized pulmonary mechanics are a key factor in selecting personalized strategies. In this case, according to the methodology proposed by Xie et al.[16] based on the CEST-to-predicted-weight ratio, a cut-off point of 0.60 ml/cmH_2O/kg can be estimated, with values below this threshold indicating low CEST and values at or above this threshold indicating high CEST. Our study found a median value of 0.67 ml/cmH_2O/kg, which could be considered high CEST.

The inspiratory pause is of great importance in clinical practice because, following the closure of the expiratory valve at the end of inspiration, Pplat is established through the cessation of inspiratory flow and airway resistance[17]. In this case, our study demonstrated that there were statistically significant changes in the variables Ppeak, Pplat, DP, CEST, Pres, and PBW in the general sample and in the NLD group. These values may be linked to the presence of pulmonary heterogeneities, and due to the lung's multicompartmental nature, a 2.0 seconds inspiratory pause may be required for complete stabilization of the medical gases in the lung parenchyma[2,7].

This type of data highlights the importance of standardizing routine pulmonary mechanics measurements, emphasizing the use of 2.0 seconds pauses for the exclusive assessment of Pplat, thereby eliminating interference related to flow restriction, air trapping, and intrapulmonary gas redistribution.

The use of the inspiratory pause goes far beyond the measure of lung mechanics. According to the study by Aguirre-Bermeo et al.[18], pause values close to 0.7 seconds allowed for a reduction in tidal volume while maintaining $PaCO_2$ levels in patients with ARDS. López-Herrera and De La Matta[19] studied a population of surgical patients and found that using an inspiratory pause of 30% of the inspiratory time led to a significant improvement in Pplat, DP, CEST, PaO_2, and the PaO_2/FiO_2 ratio.

The improvement in lung mechanics, oxygenation, and gas stabilization can be explained by the model previously described by Uttman and Jonson[20], which addresses the relationship between the increase in mean distribution time (MDT) and gas retention in the alveoli that is, the time during which the inspired gas remains in the gas exchange zone. In this case, as MDT increases, dead space is reduced, improving alveolar ventilation and the redistribution of gases from hyperinflated to collapsed alveolar units[19,20]. This type of explanation, combined with the multibehavioral theory and the heterogeneous sample profile of our study, confirms the occurrence of the observed differences in values between the 0.5- and 2.0-second pauses.

In addition to the findings regarding variations in pause duration and their impact on pulmonary mechanics, patients in the NLD group also exhibited a statistically significant increase in the Ppeak variable compared to the LD group. Although this value falls within the normal range, it must be carefully monitored on a daily basis, since, according to a study by Simonis et al.[21], patients without Acute Respiratory Distress Syndrome (ARDS) and with elevated Ppeak values had a higher risk of developing VILI and higher mortality. In this context, the prediction of this outcome could be associated with significant clinical factors, such as the presence of restrictive diseases and changes in airway resistance.

This study has several limitations: 1) a convenience sample and small sample size, which may affect the generalizability of the results; 2) the possibility of hidden comorbidities remaining undetected until the time of pulmonary mechanics assessment; 3) the sample characterization between NLD and LD patients based on the reason for intubation may not have been ideal for determining the condition of the lung parenchyma; and 4) the order of selecting the pause duration was not randomized and may be considered a source of data collection bias.

CONCLUSION

CEST values described in this study, as close to clinical reality, have a median of 37.2 cmH_2O, even in patients with existing lung disease. In addition, CEST values may be influenced by anthropometric measurements such as height and sex, which directly impact the adjustment of VT. The suggested pause time is 2.0 seconds, as this is the time required for better stabilization of gases in the heterogeneous lung parenchyma. It is believed that further studies on this topic should be conducted to help improve the individualization of pulmonary mechanics assessment.

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CONFLICT OF INTEREST

Nothing to declare.

RESEARCH DATA AVAILABILITY

Research data is available only upon request.

ARTIFICIAL INTELLIGENCE USE STATEMENT

The authors state that they did not use artificial intelligence at any stage of this study.

AUTHOR CONTRIBUTIONS

Study design: H.B.D.; B.P.M.; Data curation: all authors; formal analysis: H.B.D.; financing acquisition: H.B.D.; B.P.M.; B.M.G.; investigation: T.J.C.S; T.R.S.; B.M.G.; methodology: H.B.D.; B.P.M.; B.M.G.; project management: H.B.D.; resources: all authors; software/computer programs: H.B.D.; B.P.M.; supervision: H.B.D.; B.P.M.; validation: all authors; visualization: all authors; writing - original draft: H.B.D.; B.P.M.; B.M.G.; writing - review and editing: all authors.

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