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Research Article

Initial Static Compliance as a 28-day Mortality Parameter in Patients with COVID-19

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Abstract

Introduction: Acute Respiratory Distress Syndrome (ARDS) in coronavirus disease (COVID-19) is characterized by the rapid onset of acute hypoxemic respiratory failure and reduced respiratory system compliance. Conflicting results have been presented to consider static compliance and pulmonary shunt levels predictors of mortality. **Objective:** To analyze the initial static compliance as a 28-day mortality parameter in patients with ARDS due to COVID-19 in the intensive care unit. **Method:** Observational, descriptive, and cross-sectional study. Records of patients with ARDS due to COVID-19, over 18 years of age, who required mechanical ventilation between 2020 and 2021, were analyzed. Static compliance was analyzed, relating it to oxygen saturation on admission, age, gender, and mortality. A descriptive analysis was carried out, in addition to Mann Whitney U, Kendall's Tau-b, and Spearman's correlation, with the support of the statistical program SPSS version 24, considering a p-value less than .05 as significant. **Results:** 91 files, 68% men. Age 47 ± 13 years. The calculated compliance was 35.6±12. Mortality was 44%, and it was associated with age (p 0.001), and SOFA score (.000), but not with static compliance (.79) or days with mechanical ventilation (.785). Static compliance was lower in women (p .003), with no difference in initial oxygen saturation or age (.353 and .053). **Conclusions:** Static lung compliance was not a parameter of mortality in patients with COVID-19, mortality increases with age.

Keywords: COVID 19; Lung compliance; Acute respiratory distress syndrome

Introduction

The coronavirus disease (COVID-19) causes a severe acute respiratory syndrome, among the first symptoms are fever, cough, and shortness of breath [1], being in up to 20% of the cases a severe condition that leads to an acute respiratory distress syndrome (ARDS) requiring mechanical ventilation [2].

ARDS induced by COVID-19 is complex from a pathophysiological point of view and is suggested to be similar to classic ARDS, with acute and diffuse inflammatory damage to the alveolar-capillary barrier, with increased vascular permeability and decreased compliance [3], includes dyspnea, oxygen saturation less than 93%, relationship between partial pressure of oxygen (PaO_2) and fraction of inspired O_2 (FiO_2) less than 300 mmHg and/or bilateral pulmonary infiltrates [4], however, differences have been described in ventilatory monitoring, particularly on

the static compliance of the respiratory system (CRS). Pulmonary compliance is the pressure required to achieve a volume change and is determined by the surface tension of the fluid that lines the alveolus, which depends on the pulmonary surfactant, which makes it necessary to evaluate the static or dynamic respiratory properties in the diagnosis and prognosis, as well as in decision making [5].

There is no effective treatment for COVID 19, it has focused on symptomatic management, in case of hypoxemia oxygen therapy and/or mechanical ventilator support, Positive Expiratory Pressure (PEEP) and prone positioning are applied, however the results are different, reporting a dissociation between their lung mechanics and severity of hypoxemia, probably due to loss of lung perfusion and hypoxic vasoconstriction, suggesting that high PEEP can lead to fluid retention and hemodynamic deterioration [6], however results have been reported Contradictory regarding the association between static compliance and pulmonary shunt levels with mortality, some authors have found a higher static compliance in patients with COVID 19 compared to patients with ARDS of another etiology, while in others the compliance is similar, a multicenter study conducted in 2020 reported lower static compliance in women, associated with discharge from intensive care within 28 days and a marginal predictive value for mortality [7]. The objective of this study was to analyze the initial static compliance as a 28-day mortality parameter in patients with ARDS due to COVID-19 in the intensive care unit of the General Hospital of Zone 1, Tlaxcala.

Material and Method

Observational, descriptive, cross-sectional, retrospective design. It was carried out at the Hospital General de Zona No. 1 Tlaxcala, Mexico, with prior authorization by the local research committee 2902 with registration R-2021-2902-031, being exempt from signing consent due to the design and considered an investigation without risk. The records of patients admitted to the Intensive Care Unit (ICU) with a positive SARS-COV2 test between March 2020 and March 2021 were analyzed. Those records of patients with a history of chronic lung disease, ventilator-associated pneumonia, patients pregnant or with more than 72 hours of mechanical ventilation outside the ICU. The data (variables) analyzed were age, sex, Body Mass Index (BMI), present comorbidities, signs and symptoms, oxygen saturation at admission, mechanical ventilation parameters, plateau pressure, peak pressure, exhaled tidal volume, results of laboratory tests (initial O_2 saturation, initial pH, initial PCO_2, initial HCO_3) and laboratory tests (CT chest), length of stay in the ICU, intubation time, extubation, 28-day mortality.

After collecting the ventilatory monitoring parameters, static compliance was calculated by dividing with the formula: tidal volume/plateau pressure-PEEP, as well as the SOFA index, a database was generated, and after reviewing it, it was imported into the SPSS version 24 for analysis. The statistical tests used were frequencies, percentages, mean, and standard deviation (±) when the data were of normal distribution or median and Interquartile Range (IQR) with non-normal distribution, as well as a 95% confidence interval (95% CI). The distribution of the data was evaluated using the Kolmogorov-Smirnov test. To evaluate the relationship between mortality and age, compliance, and saturation, the Mann-Whitney U test was used, for the association with sex or comorbidities the Fisher's exact test and to relate the initial oxygen saturation with the static compliance, Spearman's correlation was used, considering a significant p-value less than 0.05 with a confidence interval of 95%.

Results

121 patients were admitted to the ICU during the study period, 30 records did not have complete studies or data.

91 records were analyzed, 69% (63) men and 31% (28) women, the age was 47 ± 13 years (range 24 to 74 years), the BMI was 29 ± 5 kg/m^2 (range 22 to 44 kg /m^2), 26% normal weight, the rest overweight or some degree of obesity. 35.2% (32) had a history of some comorbidity, 23.1% had a history of diabetes mellitus, 18.7% [17] had arterial hypertension, and 3.3% [3] had another comorbidity (bronchial asthma, ischemic disease, or cancer).

On admission, oxygen saturation was between 20 and 97%, a mean of 76%, and time with mechanical ventilation was between 4 and 56 days, with a median of 9 and IQR 8, 95% CI 10.7 -15.48. The reported respiratory rate was between 14 and 28 with a mean of 18 ± 3 rpm.

Quantitative data corresponding to parameters of mechanical ventilation and arterial blood gases are presented in Table 1. In 48.4% (44) of data suggestive of COVID-19 are reported in the chest computed tomography (CT), 42.9% (39) do not report suggestive data and in 8.8% (8) there is no CT report in the file.

	Mean	Median	DE	RIQ	IC 95%		p*
Expiratory tidal volume	412	420	48.9	60	401.52	424.05	.030
Fraction of inspired oxygen	24.07	.90	32.29	59.4	16.64	31.50	.000
Pressure PICO	27.9	28	3.55	4	27.17	28.81	.054
Plateau pressure	23.8	24	3.17	4	23.15	24.61	.013
Minute Volume	7.5	7.6	1.3	2	7.22	7.82	.200
Static compliance	35.64	34.3	12	9.3	32.87	38.41	.000
Ph	7.29	7.31	.12	.15	7.26	7.32	.091
Pa O_2	75.88	73	18.27	23	71.67	80.08	.200
Pa CO_2	49.41	46	18.32	20	45.20	53.63	.001
FIO_2	25.97	.90	33.6	54.4	18.24	33.71	.000
HCO_3	23.49	23.7	4.91	6.1	22.36	24.62	.200

PaO_2: Arterial Oxygen Pressure, Pa CO_2: Carbon Dioxide Blood Pressure. DE: Standard Deviation RIQ: Rango Intercuartil; *Kolmogorov-Smirnov test

Table 1: Parameters of mechanical ventilation and arterial blood gases.

The positive end-expiratory pressure (PEEP) described was between 6 and 30 (Figure 1). The SOFA score calculated at admission was between 2 and 15, median 4, IQR 4, mode 4 points, in 49.5% (45) of the cases the calculated score was 5 or more. Forty patients (44%) died.

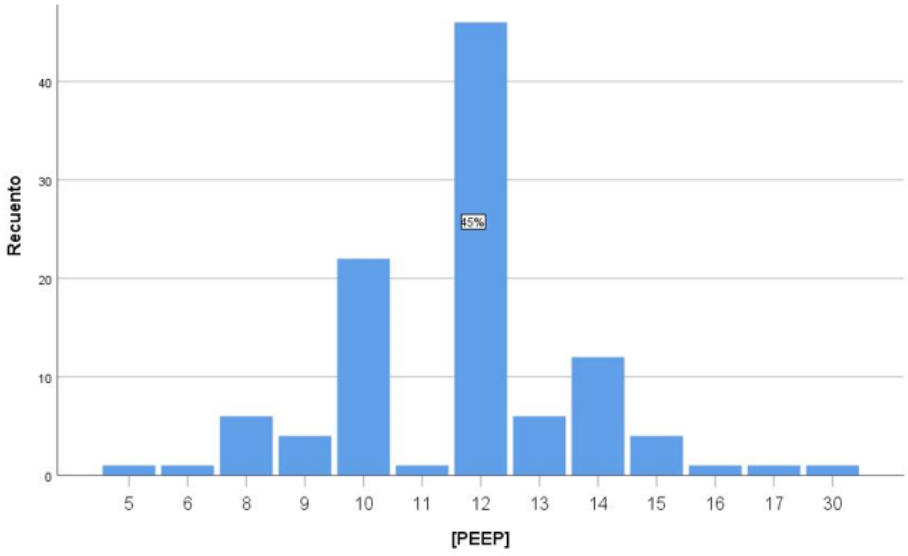

Figure 1: Positive Pressure at the end of expiration.

Mortality was not associated with BMI, days on invasive mechanical ventilation, or baseline oxygen saturation (Mann Whitney U .213, .785, and .212 respectively). Neither with sex, history of diabetes mellitus, or arterial hypertension (Fisher's exact test .154, .444, and .051 respectively).

A statistical difference was observed between age and outcome (Mann-Whitney U .001) (Figure 2), but not with static compliance (Mann-Whitney U .790) (Figure 3). Static compliance was not related to initial oxygen saturation or age (Spearman's correlation .353 and .053). With the statistical difference in sex Men 36.8± 12 IC05% 33.6-40.02 vs women 30±6 IC95% 28-30.2 (Mann Whitney U, p .003) The calculated SOFA score was related to mortality (Tau-b of Kendall .000) (Figure 4).

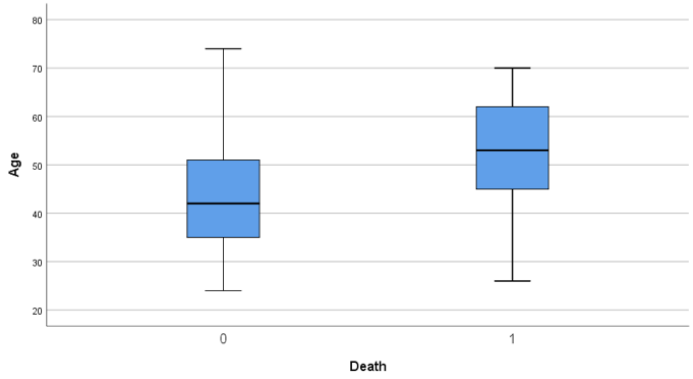

Figure 2: Age and outcome in patients hospitalized in the ICU due to COVID 19.

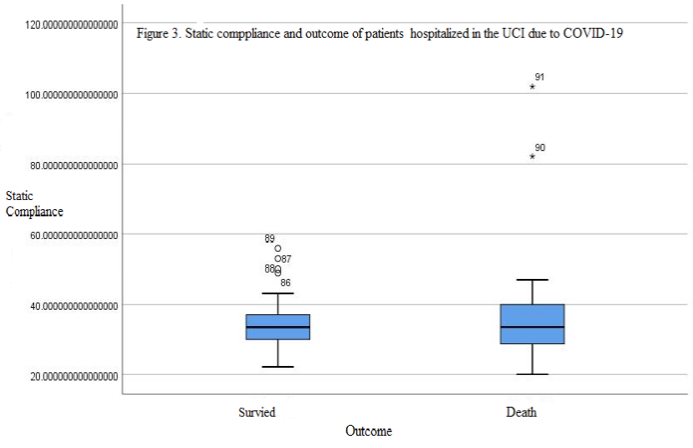

Figure 3: Static compliance and outcome of patients hospitalized in the UCI due to COVID 19.

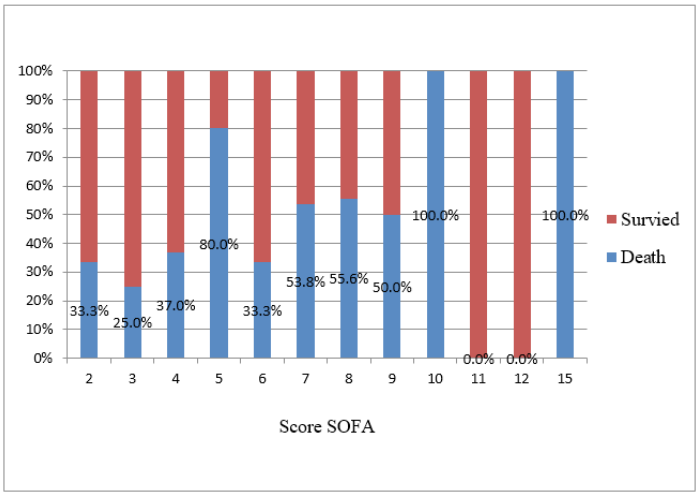

Figure 4: Mortality according to SOFA score.

Discussion

Acute respiratory failure is one of the serious manifestations of COVID 19, where all patients receive oxygen therapy and/or mechanical ventilation, with hemodynamic and ventilatory support being the cornerstone of treatment [8,9], continuous monitoring allows detecting changes clinically, indirectly assess compliance of lung tissue, rib cage, resistance, and flow [10].

In the present study, the calculated lung compliance was lower in women, observing a statistical difference about the male sex, with no relation to mortality, coinciding with what was reported by Bassi GL, et al. [7] who in a multicenter study analyzed the lung compliance in the first 48 hours after intubation, being lower in women, being associated with discharge from the Intensive Care Unit (ICU) within 28 days, suggesting a marginal predictive value for mortality.

Seeley EJ, et al. [11] in a cohort study, analyzed the pulmonary physiological variables predictive of death in the first six days of mechanical ventilatory support, reporting Pa=2/FiO_2 and low respiratory system compliance as independent predictors of death, mortality, explaining this by probable persistent pulmonary edema, atelectasis, or fibro proliferative sequelae. The reported mortality was lower than that found in this study (35 vs 44%). Coinciding with previous studies, a difference in mortality was shown about age, but not between the sexes [12].

The specific phenotypes for COVID-19 pneumonia are differentiated by the severity of hypoxemia and ventilatory

mechanics, the compliance value (static compliance) in phenotype 1 hypoxemia is associated with a figure greater than 50 ml/cm H_20, in the phenotype 2 severe hypoxemia is associated with compliance lower than 40 ml/cm H_20 [13]; in almost all the patients in the records analyzed (95.6%), lung compliance was below 50 ml/cm H_20, the average was similar to that found by Ferrando C, et al, who also did not demonstrate a difference about oxygenation [14].

The results confirm the association of the SOFA score with the risk of mortality, although in contrast to what was reported by Citu C, et al. [15] where the non-survivors had a significantly higher median than those who survived (3.5 vs 1), suggesting a hospital mortality risk score from COVID greater than 2 (sensitivity of 61.1% and specificity of 87.8%; in our study the median for non-survivors was also statistically higher (7 vs 4).

The main limitation of the study is the retrospective design, since not all, the information recorded in the files was found. Although the sample size was not that small, it was not calculated, including only files with complete data, which constitutes an information and selection bias, which does not make the results generalizable.

References

1. Blann AD, Heitmar R (2022) SARS-CoV-2 and COVID-19: A Narrative Review. Br J Biomed Sci 79: 10426.
2. Moore JB, June CH (2020) Cytokine release syndrome in severe COVID-19. Science 368: 473-474.
3. Batah SS, Fabro AT (2021) Pulmonary pathology of ARDS in COVID-19: A pathological review for clinicians. Respir Med 176: 106239.
4. Ball L, Silva PL, Giacobbe DR, Bassetti M, Zubieta-Calleja GR, et al. (2022) Understanding the pathophysiology of typical acute respiratory distress syndrome and severe COVID-19. Expert Rev Respir Med 16: 437-446.
5. Chiapero G, Rios F, Setten M (2004) Ventilación mecánica. Libro del comité de neumología critica de la SATI. Editorial panamericana. 2004. Capítulo 1. Fisiología respiratoria aplicada a la ventilación mecánica: 1-21.
6. Gattinoni L, Coppola S, Cressoni M, Busana M, Rossi S, et al. (2020) COVID-19 Does Not Lead to a "Typical" Acute Respiratory Distress Syndrome. Am J Respir Crit Care Med 201: 1299-1300.
7. Bassi GL, Suen JY, Dalton HJ, White N, Shrapnel S, et al. (2021) COVID-19 Critical Care Consortium. An appraisal of respiratory system compliance in mechanically ventilated covid-19 patients. Crit Care 25: 199.
8. Al-Qahtani AA (2020) Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2): Emergence, history, basic and clinical aspects. Saudi J Biol Sci 27: 2531-2538.
9. Carrillo-Esper R, Mejía-Gómez L, Monares-Zepeda E, Chavarria-Martínez U, Díaz-Carrillo A, et al. (2020) Abordaje hemodinámico y ventilatorio en pacientes con COVID-19. Cir Cir 88: 805-817.
10. Culser B (2001) Preoperaive Assesment of the thoracic Surgery Patient: pulmonary function testing. Semin Thorac Cardiovasc Surg 13: 92-104.
11. Seeley EJ, McAuley DF, Eisner M, Miletin M, Zhuo H, et al. (2011) Decreased respiratory system cmpliance on the sixth day of mechanical ventilation is a predictor of death in patients with established acute lung injury. Respir Res 12: 52.
12. Ruan Q, Yang K, Wang W, Jiang L, Song J (2020) Clinical predictors of mortality due to COVID-19 based on an analysis of data of 150 patients from Wuhan, China. Intensive Care Med 46: 846-848.
13. Salmorán HO, Martínez IM, Greene EJD (2022) Ventilación mecánica en pacientes con COVID-19 de acuerdo a los fenotipos de Gattinoni. Acta méd. Grupo Ángeles 18: 336-340.
14. Ferrando C, Suarez-Sipmann F, Mellado-Artigas R, Hernández M, Gea A, et al. (2020) Clinical features, ventilatory management, and outcome of ARDS caused by COVID-19 are similar to other causes of ARDS. Intensive Care Med 46: 2200-2211.
15. Citu C, Citu IM, Motoc A, Forga M, Gorun OM, et al. (2022) Predictive Value of SOFA and qSOFA for In-Hospital Mortality in COVID-19 Patients: A Single-Center Study in Romania. J Pers Med 12: 878.