Impact of Obesity on Severity of Disease in COVID-19

Jordan Edwards, Tomas Ganz MD PhD, Airie Kim MD PhD
UCLA Center for Iron Disorders, David Geffen School of Medicine at UCLA

Objective

- In COVID-19 patients hospitalized at UCLA, to determine the relationship between obesity, severity of disease, and impaired respiratory mechanics.

Background

- Coronavirus disease 2019 (COVID-19), caused by the SARS-CoV-2 virus, has created a global pandemic and infected millions of people with high morbidity and mortality.
- Over the past few decades, the prevalence of obesity (BMI > 30 kg/m²) has increased in the United States and more than 1/3 of adults and 17% of children are now obese.
- There is evidence linking obesity with severe outcomes after infection with viral pneumonia, mostly influenza A.
- There is little information on how increased body mass index (BMI) worsens COVID-19 disease and repairs respiratory mechanics.
- This study explored the association of obesity with inflammation, tissue damage, hematological parameters, respiratory mechanics and required clinical interventions in patients with COVID-19 infection.

Methods

- We performed a retrospective analysis of inpatient data from our cohort of 112 patients aged 19-94 admitted to Ronald Reagan Medical Center and UCLA Medical Center Santa Monica from 12/13/2019 to 04/16/2020.
- Patient data were extracted from the CareConnect UCLA Electronic Health Record and Graphing and statistical analysis was performed via SigmaPlot 12.5 Software.
- Data were further evaluated by gender and severity outcomes were evaluated by sentinel medical interventions admission to the Intensive Care Unit (ICU), intubation, or proning.
- The maximal (or for lymphocyte counts, minimal) blood lab values throughout the duration of hospital admission were used for analysis.
- Biochemical and hematological parameters were used to measure inflammation (peak blood levels of lactate dehydrogenase (LDH), D-dimer, C-reactive Protein (CRP), absolute lymphocyte count (ALC), and ferritin).
- Respiratory mechanics were evaluated using ventilator-derived measurements (maximum and minimum static compliance).
- Statistical analysis of parametric data was performed using t-test, and Mann-Whitney sum rank test was used for nonparametric data.
- Pearson correlation was used to determine relationships between BMI and inflammatory parameters and static compliance.

Results

Outcomes

- Analysis was also performed on patients who died during their hospital admission, but this did not show a statistically significant relationship with BMI.

Discussion

- Obesity in patients with viral community-acquired pneumonia (CAP) secondary to influenza A infection was associated with poor outcomes and significantly increased mortality compared with normal weight or under weight patients (Edwards, et al., 2013).
- Our UCLA study revealed a statistically significant correlation between elevated BMI and worse COVID-19 outcomes measured as admission to the Intensive Care Unit (ICU), invasive mechanical intubation, and requirement for paralysis while intubated.
- Previous studies have also shown that patients with elevated BMI are at higher risk of developing severe complications with viral infection such as systemic immunosuppression, leukopenia, and pneumonia (Atamna, et al., 2017).
- Obesity also causes higher concentrations of pro-inflammatory cytokines, decreasing the host immune response to viral infection; this has been specifically studied in influenza A infection (Luz, et al., 2020).
- Our UCLA results showed a strong positive relationship between BMI and blood LH levels in males under 40 years old, indicating the correlation between obesity and increased cell death and turnover.
- There was also a statistically significant positive correlation in males of all ages between BMI and blood D-dimer levels, indicating the relationship between elevated BMI and increased thrombosis and systemic inflammation.
- Although not significant, our analysis also revealed a positive trend between BMI and CRP, further suggesting the relationship between obesity and systemic inflammation.

- Males with increased BMI often exhibit central obesity, which can contribute to impaired respiratory mechanics secondary to decreased chest wall compliance and restricted lung volumes (Andersen, et al., 2016).
- The data show no evidence of the relationship between BMI and impaired respiratory mechanics, as indicated by changes in maximum or minimum static compliance values measured from the ventilator.
- There is also no relationship between BMI and changes in PaO2/FiO2 ratio after proning.

- This study only analyzed inpatient data. The use of severity data from outpatients would provide a more comprehensive analysis of the relationship of obesity and COVID-19 disease.
- This evaluation used a relatively small sample size of 112 patients. A more robust n value would strengthen the statistical analysis of this study.

Conclusions

- Obesity is an independent predictor of patient admission to the Intensive Care Unit (ICU) and the need for invasive mechanical intubation or paralysis during hospital admission.
- There is a relationship between increased BMI and elevated inflammatory parameters including C-reactive protein (CRP), lactate dehydrogenase (LDH), and D-dimer.
- The effect of obesity on systemic inflammation in COVID-19 disease is more significant in younger male patients (540 years old).
- There is no significant evidence from our study relating obesity with changes in respiratory mechanics measured by lung static compliance or improvements in the PaO2/FiO2 ratio after proning.

Limitations

- Although not significant, our analysis also revealed a positive trend between BMI and CRP, further suggesting the relationship between obesity and systemic inflammation.
- Males with increased BMI often exhibit central obesity, which can contribute to impaired respiratory mechanics secondary to decreased chest wall compliance and restricted lung volumes (Andersen, et al., 2016).
- The data show no evidence of the relationship between BMI and impaired respiratory mechanics, as indicated by changes in maximum or minimum static compliance values measured from the ventilator.
- There is also no relationship between BMI and changes in PaO2/FiO2 ratio after proning.

References


UCLA Center for Iron Disorders
Short Term Outreach Program (STTP) at the David Geffen School of Medicine at UCLA