Use of the Alveolar Gas Meter for Point-of-Care Triage in COVID-19 Patients

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Poster Disclosures: John B. West is the co-inventor of the Alveolar Gas Meter and a Consultant to MediPines

Introduction

- During the COVID-19 pandemic, decisions about which patients needed hospital beds and supplemental oxygen were strained by case volume and challenges with point-of-care decision making.
- Since most patients with COVID-19 pneumonia do not develop critical illness[1], a rapid, noninvasive assessment of oxygenation would be useful for triage decisions
- The alveolar gas meter (AGM) measures gas exchange parameters non-invasively reducing the need for ABG measurements (See Figure 1) and may aid clinical decision-making.
- The AGM oxygen deficit (OD) is an accurate surrogate for the alveolar to arterial oxygen difference (AaDO2) and is sensitive to changes in pulmonary gas exchange[2-4].
- We tested two hypotheses:
  - The OD is predictive of who will require hospital admission
  - The OD is predictive of who will need supplemental oxygen

Materials and Methods

- Patients in the emergency department or non-ICU ward who were COVID-19+ or strongly suspected to be, not on high dose oxygen.
- AGM measurements were made after 5min of breathing room air.
- The OD is obtained by subtracting the calculated arterial PO2 from the end-tidal PO2 as previously described [4].
- Data were analyzed using Microsoft Excel (Version 16.60, 2022) with an unpaired, two-tailed t-test with equal variance.
- ROC curves were generated using MatLab (Version 7.10.0, 2010, MathWorks Inc., Natick MA)

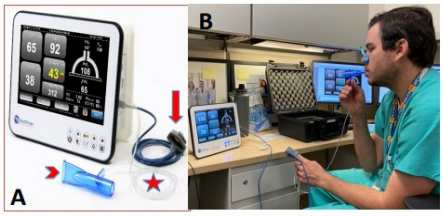

Figure 1: *Panel A* – Representative image of the AGM from MediPines Corporation (Costa Mesa, CA), co-developed by John B. West (co-author). Note the pulse oximeter (arrow), inspiratory line containing a one-way filter (star), disposable mouthpiece (arrowhead) for infection prevention/control, and compact size of the device for easy use. *Panel B* – First author demonstrating ease of use of the device.

Results

- 39 subjects with documented (n=31) or suspected (n=8) COVID-19 were enrolled. Patient characteristics can be seen in Table 1.
- Need for Hospital Admission
  - In those admitted to the hospital: **OD 45.9 (±23.2)**, (n=29)
  - In those discharged home: **OD 24.5 (±17.0)**, (n=10), **(P=0.011)** (See Figure 2)
  - An **OD >28** predicted the need for hospital admission with very good accuracy and a sensitivity and specificity both greater than 70% (See Figure 3).
- Need for Supplemental Oxygen
  - In those requiring supplemental oxygen: **OD 60.1 (±12.9)**, (n=18)
  - In those not requiring supplemental oxygen: **OD 23.5 (±16.2)**, (n=21), **(P<0.0001)** (See Figure 2)
  - An **OD ≥40** predicted the need for supplemental oxygen with excellent accuracy and a sensitivity and specificity both greater than 90% (See Figure 3).
- Interestingly, 8 of the 18 patients on supplemental oxygen maintained an SpO2≥92% on room air. However, their OD was significantly higher (51.8±9.5) than those who did not require oxygen (p<0.0001).

Characteristic	N (%)
Female	17 (44)
Diabetes	10 (26)
Obese (BMI > 30kg/m²)	14 (36)
Hispanic	8 (21)
Vaccinated Against COVID-19	15 (38)

Table 1: Characteristics for all 39 patients included in the study. *NB*: Only one patient required high flow nasal cannula oxygen and ICU transfer. No one required noninvasive ventilation, intubation, mechanical ventilation, ECMO, or died.

References

[1] Brian T. Garibaldi, Jacob Fiksel, John Muschelli, et al. Patient Trajectories Among Persons Hospitalized for COVID-19: A Cohort Study. Ann Intern Med 2021;174:33-41.
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[3] West JB, Wang DL, Prisk GK, Fine JM, et al. Noninvasive measurement of pulmonary gas exchange: comparison with data from arterial blood gases. Am J Physiol Lung Cell Mol Physiol. 2019. 316: L114–L118.
[4] Connor A. Howe CA, MacLeod DB, Wainman L, Oliver SJ, Ainslie PN. Validation of a Noninvasive Assessment of Pulmonary Gas Exchange During Exercise in Hypoxia. Chest. 2020 Oct;158(4):1644-1650.

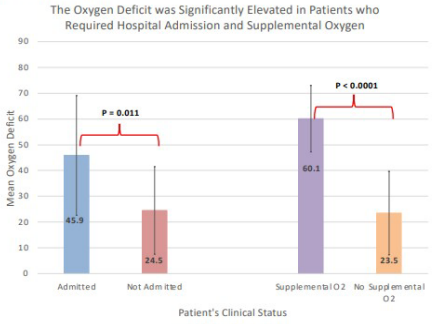

Figure 2: Patients requiring hospital admission or supplemental oxygen had statistically significant elevations in their oxygen deficit (surrogate for AaDO2) compared to those patients who did not require admission or supplemental oxygen. All OD measurements were performed on room air.

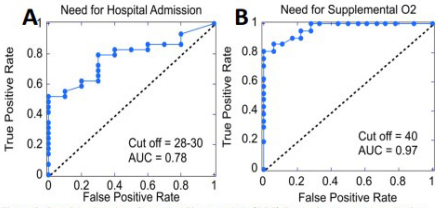

Figure 3: *Panel A* – Receiver Operating Characteristic (ROC) Curve showing an Area Under the Curve (AUC) with very good test characteristics using a cutoff value of OD > 28 for hospital admission. Panel B – ROC curve showing AUC with excellent test characteristics using a cutoff of OD ≥40 for respiratory deterioration needing supplemental oxygen.

Conclusions

- The AGM provides an early marker of gas exchange impairment in COVID-19 via the oxygen deficit, a surrogate for the AaDO2.
- Patients at risk of respiratory failure may be identified early, prior to obvious clinical deterioration, in a rapid, non-invasive fashion.
- An OD≥40 is highly sensitive and specific for supplemental oxygen administration in patients with COVID-19 while an OD>28 is modestly sensitive and specific for needing hospitalization.
- The AGM is capable of triaging patients for hospital admission and supplemental oxygen administration.

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