Multi-organ metabolic changes in COVID-19 recovery measured with total-body dynamic ^{18}F-FDG PET

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Introduction

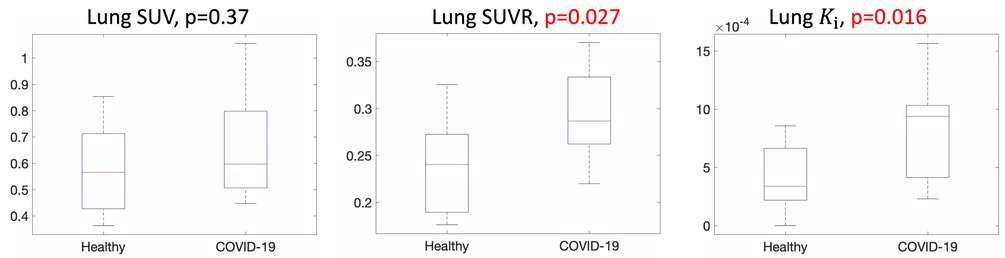
- COVID-19 can affect multiple organs and the prolonged impacts have not been thoroughly investigated.
- Total-body dynamic ^{18}F-FDG PET, e.g., on the 2-m long uEXPLORER system, when combined with kinetic modeling, allows a quantitative evaluation of metabolism in the entire body.
- In this study, we investigate the metabolic changes in multiple organs of COVID-19 subjects in the early recovery period using total-body dynamic ^{18}F-FDG PET and kinetic modeling.

Methods

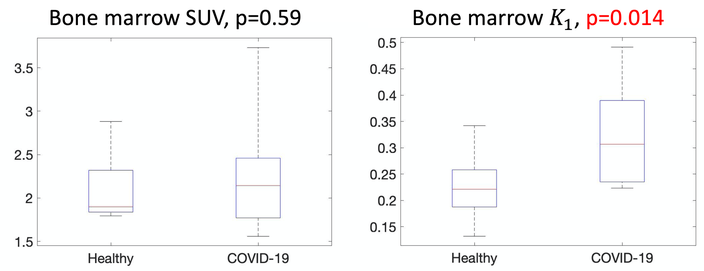
- The study enrolled thirteen healthy subjects and eight recovering COVID-19 patients who were within two months of confirmed diagnosis.
- Each subject had an ^{18}F-FDG scan on the uEXPLORER system for one hour.
- Regions of interest (ROIs) were placed in multiple organs in the reconstructed total-body images to obtain parameters. The ROI-based PET parameters include the standardized uptake value (SUV), SUV ratio (SUVR) relative to blood, ^{18}F-FDG rate constants $K_1 \sim k_4$ by compartmental modeling, and net influx rate $K_\mathrm{i} = K_1\, k_3/(k_2 + k_3)$.
- T-tests were performed to examine differences between the two groups over the parameters.
- We further generated parametric images to confirm the ROI-based findings.

Results

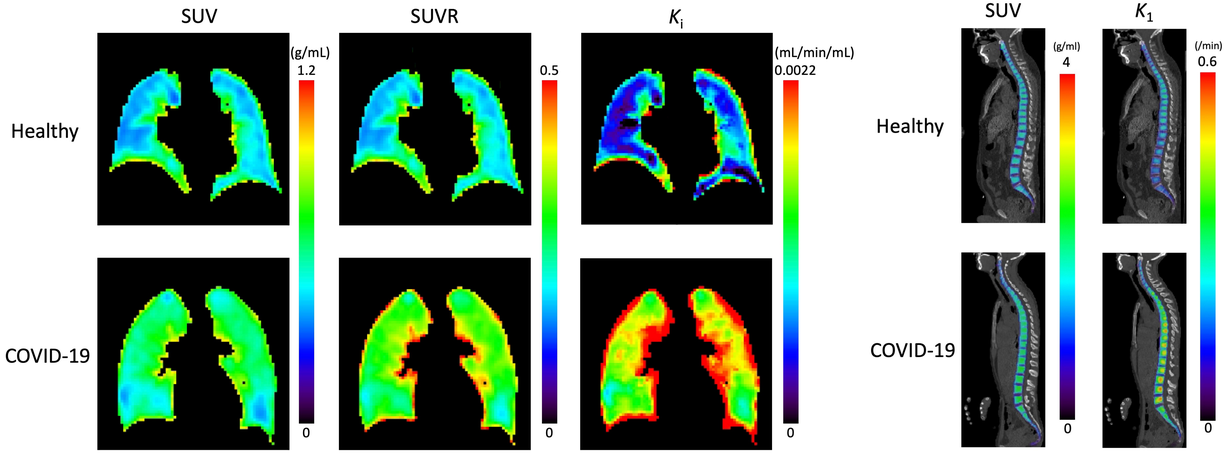
- We detected significant increases in lung SUVR (T-test p-value $p = 0.027$) and K_i ($p = 0.016$) in the COVID-19 group, while there is no significant difference in SUV (T-test p-value $p = 0.37$) between the two groups.



- For bone marrow, there is a significantly increased ^{18}F-FDG delivery rate K_1 ($p = 0.014$) in the COVID-19 group but no group difference in SUV ($p = 0.59$).



- The ROI-based findings were confirmed by parametric images.



Discussion

- The increases in ^{18}F-FDG lung metabolism (represented by SUVR and K_i) and bone marrow ^{18}F-FDG delivery (represented by K_1) may imply prolonged inflammation and immune response during the early recovery.

Conclusions/Further Study

- We detected increased lung glucose metabolism and bone marrow glucose delivery of recovering COVID-19 patients, which suggests continued impacts in early recovery.
- Kinetic quantification enabled by total-body dynamic ^{18}F-FDG PET provides a sensitive tool to monitor the metabolic changes in multiple organs.
- The study is still ongoing, and each of the COVID-19 recovering subjects will have a follow-up dynamic scan two months after the first scan. ^{18}F-FDG kinetics will be further analyzed once the follow-up scan data are obtained.

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